THE IRRIGATION AGE

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CHICAGO, NOVEMBER, 1910

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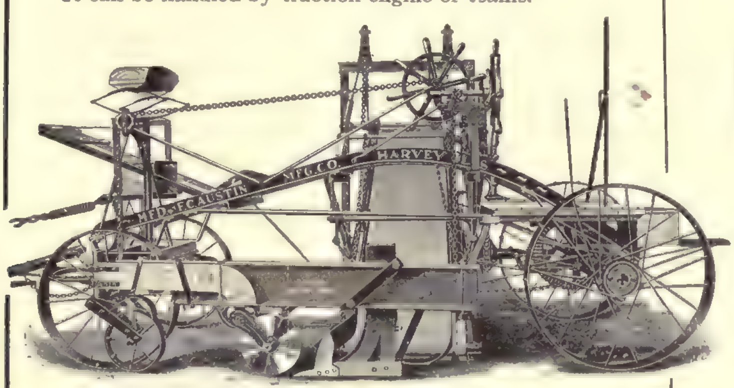

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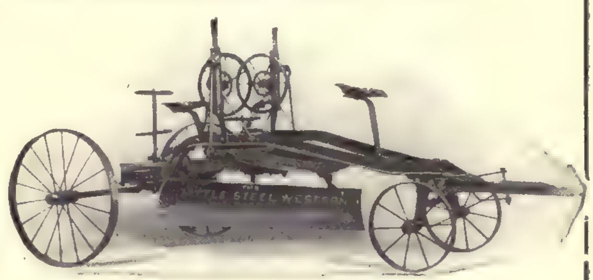

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Twenty-sixth Year

THE IRRIGATION AGE

VOL. XXVI CHICAGO, NOVEMBER, 1910. NO. 1

THE IRRIGATION AGE
With which is Merged
MODERN IRRIGATION — THE DRAINAGE JOURNAL
THE IRRIGATION ERA — MID-WEST
ARID AMERICA — THE FARM HERALD

IRRIGATION AGE COMPANY,
PUBLISHERS,
112 Dearborn Street, - - CHICAGO

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D. H. ANDERSON, Editor

ANNOUNCEMENT.

"The Primer of Irrigation" is now ready for delivery. Price, $2.00. If ordered in connection with subscription, the price is $1.50.

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Official organ of the American Irrigation Federation. Office of the Secretary, 212 Boyce Building, Chicago.

New Attitude of Railway Head in Matters of Political Control

It is evident that some of the leading railway men of this country are seeing a great light. Meddling with politics and neglecting some of the great improvement problems pertaining to their locality have injured a good many railroad companies. This is the cause of most of the hostility which people feel toward the roads.

President Mellen of the New York, New Haven & Hartford Railroad Company has become president of the Boston & Maine since that system passed under the control of the former corporation. In a recent speech at Concord, N. H., he took occasion to remark that he was "advised that the people of New Hampshire complain that the company has been too active in the political affairs of this State."

President Mellen gives public assurance that hereafter the railroad will "do nothing which is not in accord with the soundest principles which should govern public corporations in their public relations." It will not "interfere in any way with the election of members of the Legislature or of other officers," and it will not make any offer to any public officer, directly or indirectly, "of any consideration that will tend to influence him in the performance of his public duties." It will "do away with the lobby in the sense in which that term is commonly used," though it will employ "the ablest talent" to present the views of the company upon pending legislation affecting it, and at the end of the legislative session "there will be no complaint about the pernicious activity of any lobby employed in our interest," saith Mr. Mellen.

Mr. Mellen could testify that he saw the great Northern Pacific wrecked by the crowd of political leeches that it supported and enriched in its early days. Had the Northern Pacific spent as much money on irrigation systems and farm development as it did in running the politics of the Northwest up to the time Mr. Hill took it over, that company and the people along its lines would have been far more prosperous between 1880 and 1900. Mr. Mellen's words ought to be considered by many other railroad men.

Elastic Money Finally Gained as a Factor in Our Finances

By the system of forming currency associations which now is in force under the provisions of the Aldrich-Vreeland law, national banks are enabled to issue emergency circulation. This power would seem to be ample to ward off or check any panic that might threaten the financial welfare of the nation.

The principle of elasticity is applied to our money under the new law. Elasticity means that the volume of currency in the country will rise and fall according to the needs of trade. This extra circulation is purely for emergencies—for use in times of stringency. It will not be permanent, but after it has served its purpose in warding off a panic or easing up the money market, it will be recalled and held for future necessities.

The tax fixed by law on this emergency currency is high enough to insure its recall as soon as it can be spared from business channels. The law provides a tax which begins at the rate of 5 per cent per annum and

works up to 10. As the latter rate is above the legal limit in most states, it will be to the profit of the banks to get in their notes as soon as possible. They will be taxed at the rate of 10 per cent at the end of six months.

The national bank group formed in Chicago has the privilege of adding $46,000,000 to the volume of our circulating medium. Every city has a relative power. The New York group is considerably larger than that of Chicago and could put out in an emergency about $100,000,000. Boston, Philadelphia, St. Louis and other large centers could add many millions more, and groups which are to be formed by the national banks in small cities would play no small part in this general plan to stop money scares and panics.

This principle of elasticity in the circulating medium is what gives steadiness to the money market in Europe and Canada. As all emergency circulation is to be based on bonds of a high class or the best kind of commercial paper, the soundness of the plan can hardly be questioned. The emergency money is bound to be as good as all other money, which is as sound as the government or the people who stand back of it.

Indorsement of Editorials Exposing Ring Tactics

Strong and voluntary indorsements of our editorials denouncing irrigation convention politics are coming to us from all parts of the country, showing that public sentiment has been awakened to the damage being wrought by ring tactics. The real irrigation people are in this movement as a business proposition and for the good of the country. Why their efforts should be hampered by the maneuvers of a gang of petty politicians they can't understand.

There is one fact, however, which explains the situation. In every movement of a public or semi-public character there will be found a lot of disappointed politicians who are seeking places of honor and profit. No secret order is without them. A county or state fair can't be run without having their pestiferous presence as a hamper. Even the church is annoyed and injured by them. The irrigation movement has been of such a popular nature as to attract a swarm of these place hunters, who have the disposition to sacrifice the best interests of the public if they can only gain for themselves elective or appointive places which will bring their names into print occasionally.

It would seem as if a convention called for the purpose of advancing the cause of agriculture and pushing the principle of irrigation might be free from politics, but this is not to be just yet, judging by disclosures of recent years. The real irrigation people are tired of these little fellows who seek the limelight and places of influence for themselves, and it is to be hoped that the turning point has come, as we might almost declare it had after reading numerous letters approving Irrigation Age's remarks on the subject last month.

The brazen action of Pinchot and Heney in boosting B. A. Fowler into the presidency in place of Col. R. E. Twitchell was an example of the petty politics of which people are complaining. The framing up of a job to give the secretary $3,000 a year is another illustration. This scheme to supply one individual with a sinecure is pretty expensive and may be one of the final straws in breaking the camel's back. In other words, it is so rank a deal that it has opened the eyes of many men to actions which have become a curse of the association.

The whole course of such men as Maxwell, Booth, McGee and various officers of the reclamation service has tended to bring the irrigation movement into disrepute. They will be eliminated in time, as a matter of course, and the sooner the better.

Good Farming Is One Result of Irrigation

One of the best results gained from irrigation is good farming. People who buy irrigated land usually take small tracts and proceed to work them on the intensive principle. The aim is to make the soil do its best. Therefore the most intelligent and successful farming in America today, outside of experimental stations, is in the irrigated sections.

The tendency of every person owning a farm of ten to forty acres is to do thorough work, and accomplish through this means as much as is gained ordinarily on one hundred or one hundred and sixty acres. A majority of those buying these small farms are practical men who desire in the first place to get land of their own, and secondly to have an opportunity to conduct a farm on progressive lines. The thousands of tenant farmers in the older sections of the country are not able to get land where they are at any figure within their means, as owners usually hold their property in large tracts, believing that ultimately it will be most profitable in such shape. These people can buy the little farms in irrigated sections and win success on them.

Tenant farming is a sort of bondage that is hard to break, but while it is increasing in the older states, where retired farmers or capitalists hold their land in large blocks, there is a keen desire on the part of nearly all who operate rented places to possess land and dwellings of their own. How farm tenantry is increasing in the United States is shown by the following table:

	1880.	1890.	1900.
Owners	74.5%	71.6%	64.7%
Tenants	25.5%	28.4%	35.3%

This is a grave situation, and no movement is more deserving of encouragement than one that aims to free men from it. The free man is the man who controls the sources of his own support. The tenant must take the most overworked and impoverished land and raise the least profitable crops. He has no fixed place of abode. His annual rent is a perpetual debt and himself and family are mere driftwood. He shares but little in the general prosperity. All times to him are hard times. The most important step in national progress is the effort to provide homes for the men who desire to be independent and own the land they live on.

The director of the United States Reclamation Service, F. H. Newell, says: "The West is developing rapidly. We are putting good substantial settlers on forty-acre tracts. They are men of large families. This dense population means much for the country and for the settler."

But the director adds a word of caution: "The irrigated countries are no place for the poor farmer. The man who goes there must use his brains in all his farming."

The little farm is for the progressive man, whether he buys it outright or takes it under the Reclamation Act. Wherever the up-to-date farmer acquires one of these little tracts in the irrigated section of the West we can depend on seeing good results.

Irrigation Age Twenty-six Years an Advocate of Progressive Ideas

With the present issue IRRIGATION AGE rounds out a period of twenty-six years as an advocate of progressive ideas in agriculture. For more than a quarter of a century this paper has labored to promulgate the principles of irrigation and intensive farming as a means of advancing the nation's prosperity and elevating agriculture to the dignity of a business.

While IRRIGATION AGE has prospered and attained a circulation and influence never reached by another paper of its class, we believe it proper to say that there are many persons enjoying benefits from our publicity efforts who have been remiss in aiding and supporting this or any other publication devoted to the principles for which we have labored.

This being the oldest and most widely read of all irrigation papers, it is our right and duty to say that neither the government officials, the railroads nor the manufacturing companies which produce irrigation machinery, have given proper support to publications like this, which steadily and intelligently push the propaganda of an artificial water supply in American agriculture. Most of our patronage has come from individual subscribers who understood the importance of the work. Some who have had the most to gain from the development of the semi-arid portions of the country failed to grasp the issue, and hence all developments have been too slow for the good of the public.

It is true that irrigation is making headway, but it is equally true that it would have advanced much more rapidly had all western bankers, railroad companies and manufacturers taken an active instead of a passive interest in the subject. In the quarter of a century of its existence IRRIGATION AGE has absorbed a half-dozen publications of decided merit, which were struggling to do what we have done in spreading the important principles which underlie our efforts. All of these starving journals ought to have had support from advertisers and the reading public, and in almost any other line of endeavor they would have received a more liberal patronage.

There is no kind of enterprise connected with the development of our western states that has needed printers' ink and publicity any more than has irrigation. The interest requires specific and technical knowledge, and not the haphazard views of journalists who present an occasional article on the theme. We repeat, that those who are the gainers by the spread of irrigation propaganda should be more enterprising in their patronage of publications like IRRIGATION AGE. There is a mighty work yet to be done, and they should assist.

In this connection we wish to warn irrigationists to keep politics out of their business affairs and conventions. When men are found to be pushing themselves forward in this cause for self-aggrandizement rather than for the advancement of irrigation princples, it would be well to give them the cold shoulder and a back seat. There is no place for petty politics in this great national movement. Let us build up the irrigation systems of the various states in a business-like way. The personal schemes of rings and cliques are plainly dangerous. They are inimical to the best interests of an important cause. Get rid of them and keep clear of them.

IRRIGATION AGE has had an uphill fight, but it has won the battle. This paper is now recognized in a national sense as an authority in its particular field. Probably it will be better supported and will accomplish more for the public in the next quarter century than it has in the past. One thing is certain, the great work of irrigating the semi-arid sections of the country has only fairly begun. There ought to be harmonious and spirited action from this time on, and every year ought to see tangible results accomplished. We hope to lead in this work more energetically than ever, for our enthusiasm never was higher, and we hope for a spirit of cordial co-operation on the part of many who have so far only extended their help in a half-hearted manner.

THE ARKANSAS VALLEY.

BY R. E. WALLACE.

THE writer recalls that in the school days of long ago, he was subject to a reprimand for taking too big a subject in essay writing; that is, it was a topic that could not be covered by one small individual in one small essay. He has a little of the same feeling that he is tackling a big subject when he is writing on the Arkansas Valley in eastern Colorado. It is a big subject, and needs to be treated in a big way.

The developments of the Arkansas Valley have been remarkable in the last few months. The attention of people in the east has been generally directed toward that valley for several reasons. First, its fertility, and second, its water supply, the first of course being contingent on the second.

Someone has been gifted with enough of sentiment to speak of this valley as "a heart of gold in a ribbon of green," and this is a feature of agricultural conditions that impresses itself on one's mind, whether he be a poet or one of the plain people. The vast fields of alfalfa, which flourish so vigorously in the valley, make it indeed a vast ribbon of green. One is prone to question whether there is a market for such quantities of alfalfa as are grown in the Arkansas Valley, but a little investigation, a few talks with the people who live there, set one's mind at rest on that score.

The writer talked with a Mississippi planter a few weeks ago, who was disposed to be pessimistic on the matter of raising so much alfalfa. He declared that the vast fields of this crop growing in the west and now beginning to appear in the south, would soon flood the market, and that prices would drop away down, possibly as low as those which prevailed during the panic days of 1892 and 1893. Not so, however, with the optimists of Colorado, and men who are growing alfalfa in the Arkansas Valley. They have no such fears, and need have none. Aside from its being a crop that is bringing wealth into every community, it is also, as is well known, bringing to the soil those millions of atoms and pounds of nitrogen with which the air is filled, and if there should ever be an over-production of alfalfa, it could soon be turned over, and put into the soil in a way that will bring other crops fully as profitable.

Not many portions of the west are as well favored in their water systems as is the Arkansas Valley of eastern Colorado. The Fort Lyon and Amity systems are practically a unit, and are caring for the farms dependent upon them in a way that is beyond criticism. It is a peculiar fact that in many of the localities the water systems or the managers of same, are subject to much criticism, and litigation seems to sprout every time water is turned into a ditch. With both the Fort Lyon and Amity peace and quiet reigns, and the managers are working in harmony. The reservoirs of these systems are large enough to be called inland seas. Reference has been made to them in the columns of THE IRRIGATION AGE in a previous issue. The priority of the water rights is as firmly fixed and as secure as the rights of any irrigation system in the west, and the best attorneys have passed upon these facts.

Of course there are other crops with which the Arkansas Valley is favored besides that of alfalfa, as mentioned above. The grain crops, wheat in particular, being very prolific, a record having been made this last season of 69 bushels to the acre, and the growing of sugar beets and of melons is as profitable as in other parts of Colorado.

The tendency is toward smaller farms and the crops that make the small farms profitable, that is, intensive cultivation. Orchards are being planted all along the valley, and there is no reason to believe that the conditions are different than those existing at Rocky Ford, where the orchards are one of the commercial factors of the country. At Holly the melon industry has developed very rapidly, and a market is being created in the east for Holly melons, which points far to make the Rocky Ford people sit up and take notice at a little later date.

The sugar beets are well taken care of by the factories in the valley. Two of these are independent, and three are in the hands of what is known as the Sugar Trust. The beets of the Arkansas Valley, by reason of the hot summers and certain elements in the soil, are sweeter than in other parts of the country, and for that reason the factory at Holly and the one at Swink changed their method of paying for beets, the percentage plan now being in the contracts. If a man's beets range above 15 per cent of sugar content, he is paid accordingly. Last year the best beets taken from Holly showed a percentage of 22.8. At the present rate of payment, this would mean nearly $7.00 a ton for the beets.

View Showing Concrete Construction on Canal Work Near Holly, Colo.

The transportation facilities of this valley are also important, and do much to attract settlers. The main line of the Santa Fe runs along the south side of the river, while a road now owned by the Santa Fe, but originally called the "Sugar Road," runs along the north side of the river from Holly to Swink. These two roads with their many stations, simplify the matter of transportation, and make farms in that valley desirable. Few, if any, of the farms that are under irrigation are more than three or four miles from a station.

The towns of the valley are thrifty, wide awake, and the sort that attract strangers, and as the country becomes more thickly populated, naturally the little cities grow rapidly. The special efforts being made in colonizing large tracts of land in the valley in the last few months have all given an impetus to the growth of the towns, and the people of Lamar and those of Holly look for a doubling in the population in the next five years or less. Along the Sugar Road are some thriving little places, which are also ready to assume city airs and anticipate a rapid growth.

When one reflects on the Greeley District through northern Colorado, with which comparison is always made when one speaks of the growth of an irrigated country, it is plain to see that the towns share in the growth of the country. Both Greeley and Fort Collins with a trifle over 3,000 population in 1900 have grown to three or four times that in 1910. The same is true of Loveland and Longmount and other towns in that district. Basing their calculations upon these facts, the towns of the Arkansas Valley ought to more than double in the next five years. The conditions of the country warrant these conclusions, because of the rapidity with which the lands are being bought up and settled. The investments that are being made in the Arkansas Valley are almost entirely by those who contemplate making their homes there, and not by speculators.

The success of the irrigation projects now in operation in the valley has also attracted the attention of capitalists, and other larger projects are being planned on both the north and south sides of the river, on the tables lying from six to ten miles from the river.

The Arkansas Valley is indeed a fertile land, and where now there are scattered farms, villages and towns, in a few years there will be a million people, possibly more, all supported by or living upon the irrigated land.

A NEW IRRIGATION PROJECT FOR WASHINGTON.

JOSEPH JACOBS, C. E., has begun work on the permanent survey for the Quincy Valley project in the state of Washington. One engineering crew is already at work on the reservoir site and dam site at Wenatchee Lake in the Cascade Mountains, from which source the famous Wenatchee Valley district draws its water supply for irrigation.

The Quincy Valley project covers from 300,000 to 400,000 acres of land in Grant County, adjacent to the Wenatchee apple district. The two districts are separated by the Columbia River.

The Quincy Valley district is especially adapted for raising winter apples.

The building of this project involves the construction of a syphon across the Columbia River, through which water will be brought across the Columbia River from Wenatchee Lake.

The project has been financed by eastern capitalists and will be completed at the earliest possible date.

BOND MARKET IMPROVING.

The demand for high grade bonds continues to gain strength in the market. Buyers have become very critical, but there is a steady demand. Irrigation bonds that are known to be safe are well thought of and there may be extensive dealing in them before long.

View of Main Canal Near Holly, Colo.

ARID AGRICULTURE

BY

B. C. BUFFUM, M. S.

Manager of the Wyoming Plant and Seed Breeding Company, Worland. Former Professor of Agriculture in the University of Wyoming and the Colorado Agricultural College, and Director of the Wyoming Agricultural Experiment Station.

ALFALFA.

ALFALFA IN WESTERN ARGICULTURE.

PROF. B. C. BUFFUM.

Alfalfa has been and is the making of the West. No other plant can take its place in arid agriculture. It makes the richest hay and is the best all-round forage; is best adapted to climate and soils; it solves the problem of soil fertility and maintenance. Alfalfa is not only essential on every irrigated farm, but it is a drouth resistant hay crop for the dry farmer. Its value as a stock food has given it fame, not only in the West, but in all parts of the country. Alfalfa is now being brought into almost every state and introduced into every country in the world. Its value has become so well recognized that the demand for alfalfa seed far exceeds the supply. This makes the growing of alfalfa for seed an important new industry for this region where seed can be successfully produced.

ALFALFA SEED CULTURE.

Up to the present time the production of alfalfa seed has simply been incidental. When alfalfa land has been plowed and put into grain crops the plants which come up from the old crowns produce seed. When the grain is threshed, this seed is separated and saved and has furnished a considerable portion of the supply. Very few have planted alfalfa for the purpose of producing seed. When alfalfa fields get old, run out, and the plants thin so that they do not produce sufficient yield of hay, it is the common practice to leave them for seed. Such fields give yields of from two to seven bushels of seed per acre. Old plants produce small amounts of seed. For large crops young and vigorous plants are necessary. There are three secrets in successful alfalfa seed production. First, isolation of the plant; second, young and vigorous plants; third, favorable conditions of growth.

METHOD OF PLANTING SEED.

Alfalfa for seed should not be sown as the ordinary hay crop. To secure plants which are far enough apart to make strong, thrifty growth; to secure proper fertilization of the flowers; to prevent crowding; to favor cultivation and irrigation, seed should be thinly sown in rows from two and one-half to three and one-half feet apart. The method recommended is to take off the shoes or stop up the holes of a drill to make the rows as wide as wanted, and then plant as little seed as possible (two or three pounds per acre). The small amount of seed may be mixed with ashes or soil to help spread it evenly. When the plants come up, if they are too thick in the row, they may be spaced with a hoe, as with sugar beets, or when very small may be harrowed crosswise to take out part of the plants.

CULTIVATION FOR SEED.

Where alfalfa seed is raised under dry farming conditions, the plants may be cultivated when very small, as are sugar beets, with a cultivator supplied with "duck feet," or "bull tongues." After the plants are a year old the cultivation may be done with a disc or alfalfa harrow. After the plants begin to produce seed, it will be necessary to cultivate carefully in order to prevent thickening up from the growth of seed which is shattered off the parent plants. Under irrigation we would give the same cultivation as for dry farming, and in addition it will be necessary to ditch deeply between the rows. These ditches should be made before the plants get too large.

IRRIGATION FOR SEED.

Alfalfa raised for seed production should never be allowed to get dry or to suffer for water. The key to the method of raising alfalfa seed is furnished by those plants which grow along ditch banks. Such plants which are never flood irrigated, which never get dry, which are not crowded, always produce seed abundantly. If the plants get so dry that growth is stopped, an irrigation will start new growth from the crowns, which interferes with or destroys the crop.

HARVESTING AND THRESHING.

The problem of harvesting alfalfa seed grown by irrigation where the rows are wide and the ditches are deep, has not been worked out. No machine has been constructed for this work. It would seem, however, that the crop is sufficiently profitable to pay for hand work until such time as invention supplies a better method. The seed should either be placed in bundles or tied and allowed to get thoroughly dry before it is stacked. It should be threshed with the alfalfa huller. An ordinary threshing machine does not do clean work and wastes too much seed. The seed should be stored in a dry place where there is not likely to be great changes in temperature.

PROBABLE YIELDS.

Alfalfa seed grown in culture for this special purpose should produce heavy crops. One crop of twenty-eight bushels

Turkey Red Winter Wheat, Dry Grown, at Newcastle, Wyoming, 1908.

of alfalfa seed per acre has been reported; in another authenticated case a crop was raised of nineteen and one-half bushels of seed per acre on three acres. These yields show the possibilities of the crop. An average of fifteen to twenty bushels per acre should be secured by correct culture and treatment. With an expense of $20 an acre, the profit ought to be equal to that from the culture of other intensive crops, like sugar beets and potatoes.

FERTILIZATION OF THE FLOWERS.

It has generally been believed that alfalfa, like other clovers, required the visitation of insects to fertilize the flowers. Failure of the seed crop is often due to lack of proper fertilization. It is known that alfalfa flowers may become fertilized without the agency of insects. Alfalfa flowers are supplied with a little trap, the springing of which insures getting the pollen where it is needed. The honey bee seems to be one of the most important agents for fertilizing alfalfa. Alfalfa is one of the best honey plants known. Every alfalfa seed raiser should keep bees.

WILL THERE BE A SEED CROP?

It is impossible to tell early in the spring whether or not a crop of seed will be secured. If the season is very wet and cold and the plants make large, thick growth, it will be better to cut the first crop instead of letting it go to seed. If the blooms are light in color and are few, if the flowers do not fertilize, but fall off, leaving the stems bare; if only one or two weak looking pods are produced in a flower truss and there is a small amount of curl in the pod or only one or two seeds appear in it, the crop had better be cut for hay. Sometimes there is early insect injury, as from grasshoppers or early appearance of leaf-spot or other disease which indi-

cates that a profitable seed crop will not be secured. Sometimes the bloom will increase and become well fertilized later in the season, but these early indications are almost sure evidence of what may be expected.

CLIPPING YOUNG PLANTS.

The young alfalfa plants sown in rows for seed should be clipped in late summer or early fall of the first season. This

Wonderful Alfalfa Grown in Northern Wyoming. Tallest Specimens Were 9 ft. and 2 in. High.

clipping should be done not more than half way down the plant. Cutting close to the ground may injure or destroy the young plants. Proper clipping greatly strengthens the plant, causing it to produce larger roots and more thrifty crowns.

CROP FOR SEED.

The first crop should ordinarily be left for seed, in our Northern mountain regions. In any district north of Colorado the second crop is not so certain, although it is true that the second crop will often seed better than the first. This is probably due to more numerous insects for the fertilization of the flowers later in the season. Where the season is long, so four crops or more of alfalfa are cut, the first crop may be clipped or cut for hay, and the second crop used for seed.

TIME TO HARVEST SEED.

Alfalfa for seed should be cut before it gets too ripe. If allowed to stand too long or there is a shower of rain after the pods are fully ripe, they will shatter and there will be much loss. It is best to cut the seed crop when the alfalfa stems are still more or less green, or when a majority of the seed pods have turned brown. The earlier ripened seed is probably best, and that which is green or immature can be blown out with the fan.

STACKING FOR SEED.

The alfalfa bundles or gavels from the self-rake should be piled together for protection from rain and to prevent shattering, by handling as large bundles as convenient. When thoroughly dry, these bundles should be put in the stack. Alfalfa for seed should be stacked several weeks, or long enough to get through the sweat before threshing. Never put alfalfa in the stack when there is moisture on the outside of the leaves or stems. Much alfalfa seed is destroyed by heating in the stack. If the stacks are large, some form of stack ventilator should be used. There should be a stack bottom of poles or other material to keep the alfalfa off the ground, and open barrels or other frames may be put inside the stack to serve as ventilators. This applies to alfalfa for hay as well as for seed.

VARIETIES OF ALFALFA.

The author is now growing a total of forty-two varieties and strains of alfalfa. Many of these are more properly varietal strains from different parts of the world. While there are few varieties of alfalfa on the market, the seed buyer has some choice, and it is important that he make his own decision rather than let the seedsman choose for him. The varieties offered by seedsmen are: common alfalfa, which covers a multitude of forms; Turkestan alfalfa, the seed of which has a brown or reddish tinge; German alfalfa, often identical with the seedsman's Turkestan, and Grimm's alfalfa, which is said to be an American strain of sand lucern. Plants of Turkestan alfalfa are so much like our common form that they are indistinguishable. The value of this strain is not that it is a different type, but that the seed has been grown under conditions of drouth, which give it strength and vigor when changed to our soil conditions. German alfalfa seed has done well in some localities, but has nothing specially to recommend it. Of common alfalfa seed the discriminating planter will choose well when buying. That which is grown in the north will give better results than that which is grown in southern sections of the country. In some regions, alfalfa seed usually becomes contaminated with sweet clover. Any one with acute sense of smell can detect sweet clover seed in alfalfa. There is no way of separating it, and while sweet clover is not a bad weed in alfalfa fields (except in those for seed production), the buyer does not like to be fooled with any such adulterant. It is important that varieties of alfalfa which are resistant to leaf-spot diseases and adapted to our conditions of soils and climate should be produced.

GOOD SEED.

Good alfalfa seed varies in color, but is usually a bright golden yellow, or it may have a slight greenish tinge. It should be practically free from black, shriveled, immature seeds; it should be entirely free from dodder and other dangerous weeds. It should be viable—alive, and germinate promptly when planted. Alfalfa and other leguminous seeds often become so hard that they will remain in the soil a year or more before they germinate. Good seed is that which will make the strongest growth, and such seed is usually produced in the shortest season.

SOILS FOR ALFALFA.

Alfalfa will grow and thrive on almost any character of soil found in the west. The kind of subsoil is more important

A Good Way to Make Large Stacks.

than that of the surface. If the subsoil consists of hardpan or is filled with moisture which comes near the surface, it is not so suitable for alfalfa. Some of the strongest soils which produce the heaviest crops are the clays and greasewood lands, but it usually takes longer to get alfalfa established in such soils. With proper soil management, alfalfa will grow almost anywhere. If the soil is shallow, it requires more irrigation. If it is heavy clay, also more irrigation will be required. If the sub-surface water changes its position through the year, being several feet lower in the growing season than it is in the winter or spring, its rise will usually drown alfalfa. Alfalfa is not very resistant to strong alkali soils. At high altitudes where the season is short, more care will be needed in its culture, and under dry farming special attention to the conservation of moisture is necessary.

(Continued in December Number)

Irrigation of Orchards

BY SAMUEL FORTIER

Chief of Irrigation Investigations, Office of Experiment Stations, U. S. Department of Agriculture

Applying Water to Furrows.

In the Payette Valley, Idaho, 200 or more miners' inches are turned into the head ditch and divided up by means of wooden spouts into a like number of furrows. On steep ground much smaller streams are used. The length of the furrow varies from 300 feet on steep slopes to 600 feet and more on flat slopes. The time required to moisten the soil depends on the length of the furrow and the nature of the soil. In this locality it varies from 3 to 36 hours.

J. H. Foreman owns 20 acres of bearing orchard under the Sunnyside Canal in the Yakima Valley, Washington, and waters it four times in each season with 14 miners' inches (0.35 cubic foot per second). He makes three furrows between the rows, which are 40 rods long. The total supply is applied to one-half the orchard (10 acres) and kept on 48 hours.

On the clayey loams of the apple orchards on the east branch of the Bitter Root River, Montana, Prof. R. W. Fisher has found, as a result of experimenting, that it requires from 12 to 18 hours to moisten the soil in furrow irrigation 4 feet deep and 3 feet sideways.

In 1908 Mr. Struck, of Hood River, Oregon, irrigated 3 acres of apple trees in furrows 350 feet long, spaced 3 feet apart. About a miners' inch of water was turned into each alternate furrow from a wooden head flume and kept on for about 48 hours. After the soil had become sufficiently dry it was cultivated, and in 8 or 10 days thereafter water was turned into the alternate rows, which were left dry during the first irrigation.

For the most part, the furrows are made parallel to the rows of trees. An arrangement of this kind is satisfactory in young orchards, but as the trees reach maturity their branches occupy more of the open space between the rows and prevent the making of furrows near the trees. This is easily accomplished where a space of 6 to 12 feet square, according to the size of the trees, is not furrowed. This space usually becomes so dry that it is worthless as a feeding ground for roots. In order to moisten these dry spots a larger stream is often carried in the two furrows next to each row of trees and the surplus led across in short furrows, thus supplying water to the dry spots. Instead of continuing straight and cross furrows, as is sometimes done, use is frequently made of the diagonal zig zag furrows, to moisten the dry space between the trees. This last method is best adapted to grades of 5 inches to the 100 feet or more.

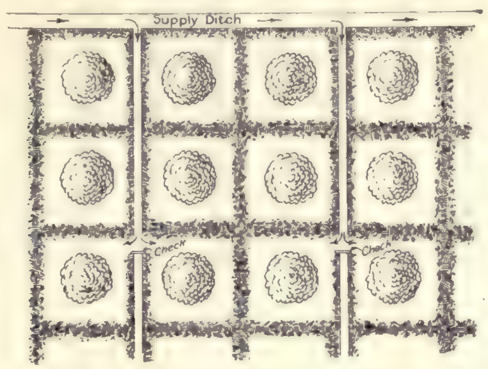


Fig. 22.—Basin Method of Irrigation.

A method and the cost of one irrigation is described as follows:

The implement used to make furrows consists of three shovels attached to a beam which is mounted on a pair of low wheels. The driver sits on a riding seat and by operating a lever can regulate the depth of the furrows. A man and two horses will furrow out 10 acres in a day. For a distance of 150 feet from the top of the orchard furrows are straight. They are then zigzagged to within 60 or 70 feet of the bottom, where the last three rows of trees are irrigated by basins which catch the surplus. In the case described the depth of furrow was 6 inches, length 800 feet, and distance apart 3 feet. A head of 50 miner's inches (1 cubic foot per second) was used on 10 acres. The streams when first turned into the furrows averaged about 2 miner's inches, but as the water approached the lower end they were reduced to 1 miner's inch or less, and this flow was run in each furrow for 12 to 24 hours.

The items of cost for 10 acres were as given below:

Making furrows and basins	$ 6.50
Irrigating	3.00
Fifty inches of water, 24 hours, at 40 cents an hour	9.60
Rent of water stock	12.00
Total	$31.10

The Basin Method.

Orchards are sometimes irrigated by first forming ridges midway between the rows in two directions at right angles to each other. This divides up the tract into a large number of squares with a tree in the center of each, as maye be observed in Figure 22.

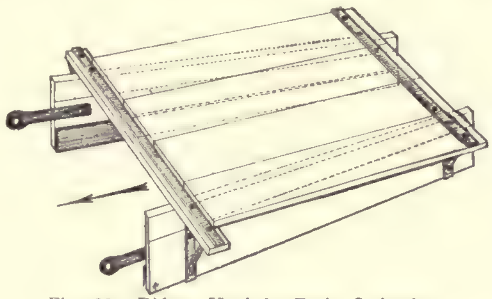


Fig. 23.—Ridger Used in Basin Irrigation.

When the ground is hard or covered with weeds, a disk plow is first run between the rows and then the loosened earth is formed into a ridge by a ridger. If the soil is light, sandy and free from weeds, the disking is not necessary. Ridgers are made in various ways of both wood and steel or some combination of both. A common kind is shown in figure 23. It consists of two deep runners 14 to 18 inches high, 2 inches thick, and 6 to 8 feet long. These runners are shod with steel which extends part way up the inner side. They are 4 to 5 feet apart at the front end and tapered to 16 to 24 inches at the rear. The runners are held in position by cross pieces on top, a floor, and straps of steel in the manner shown. The height of the ridges varies with the depth of water applied, which is from 4 to 9 inches. The ridges should be several inches above the surface of the water when a basin is flooded.

Several methods of flooding basins are practiced. In one a ditch is run from the supply ditch at the head through each alternate row space and the basins on each side are flooded in pairs beginning with the lowest. This plan is shown in outline in Figure 22. In the other method water is allowed to flow through openings into each basin of a tier in a zigzag course from the top to the bottom of the orchard. In this plan the upper basins receive the most water. Under gravity canals, where water is abundant, the water is turned into the upper basin until it is full, when it overflows into the next, and so on down the tier. The irrigator then begins at the lower end and repairs the breaks, leaving each basin full of water.

The Check Method.

Where this method is practiced it frequently happens that land on which alfalfa has been grown is planted to fruit trees. In plowing down the alfalfa and setting out the trees, the levees undergo little change and the checks

can be flooded if it is considered best. A better plan is to furrow the floor of each check as shown in Figure 24. The water is admitted through the check box which was used for the alfalfa and conducted into a short head ditch, from which it is distributed to the furrows. The chief objection to this method is that the checks are too small for orchard tracts in furrow irrigation.

Time to Irrigate Orchards.

The best orchardists believe that frequent examinations of the stem, branches, foliage, and fruit are not enough. The roots and soil should likewise be examined. The advice of such men to the inexperienced is: Find out where the bulk of the feeding roots is located, ascertain the nature of the soil around them, and make frequent tests as to the moisture which it contains. In a citrus orchard of sandy loam samples are taken at depths of about 3 feet and the moisture content determined by exposing the samples to a bright sun for the greater part of a day. It is considered that 6 per cent by weight of free water is sufficient to keep the trees in a vigorous condition.

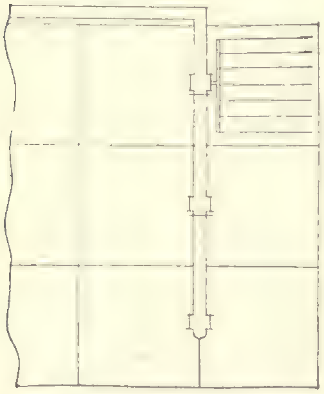


Fig. 24.—Combination of Check and Furrow Methods.

Doctor Loughridge, of the University of California, in his experiments at Riverside, Cal., in June, 1905, found an average of 3.5 per cent in the upper 2 feet and an average of 6.16 per cent below this level in an orchard which had not been irrigated since October of the preceding year. It had received, however, a winter rainfall of about 16 inches. On examination it was found that the bulk of the roots lay between the first and fourth foot. These trees in June seemed to be merely holding their own. When irrigated July 7 they began to make new growth. A few days after the water was applied the percentage of free water in the upper 4 feet of soil rose to 9.64 per cent. The results of these tests seem to indicate that the percentage by weight of free moisture should range between 5 and 10 per cent in orchard loams.

Many fruit growers do not turn on the irrigation stream until the trees begin to show visible signs of suffering, as a slight change in color or a slight curling of the leaves. In thus waiting for these signals of distress, both trees and fruit are liable to be injured. On the other hand, the man who ignores these symptoms and pours on a large quantity of water whenever he can spare it, or when his turn comes, is apt to cause greater damage by an overdose of water.

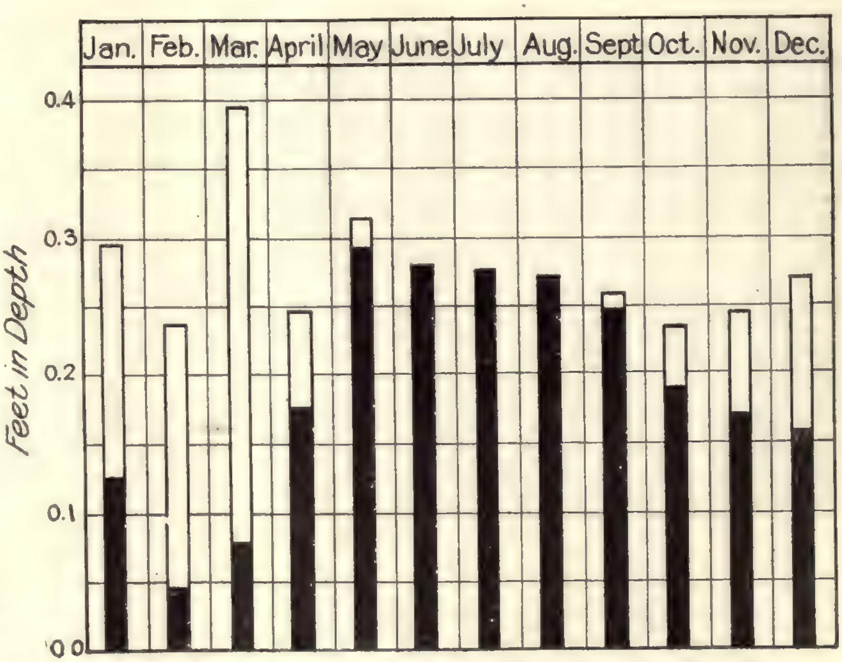


Fig. 25—Average duty per month under Riverside Water Company, December 1, 1901, to November 30, 1908.

Number of Irrigations Per Season.

For nearly half the entire year the fruit trees of Wyoming and Montana have little active, visible growth, whereas in the citrus districts of California and Arizona the growth is continuous. A tree when dormant gives off moisture but the amount evaporated from both soil and tree in winter is relatively small, owing to the low temperature, the lack of foliage, and feeble growth. A heavy rain which saturates the soil below the usual covering of soil mulch may take the place of one artificial watering, but the light shower frequently does more harm than good. The number of irrigations likewise depends on the capacity of the soil to hold water. If it readily parts with its moisture, light but frequent applications will produce the best results, but if it holds water well a heavy application at longer intervals is best especially when loss by evaporation from the soil is prevented by the use of a deep soil mulch.

In the Yakima and Wenatchee fruit-growing district of Washington the first irrigation is usually given in April or early in May. Then follow three to four waterings at intervals of 20 to 30 days. At Montrose, Colo., water is used three to five times in a season. At Payette, Idaho, the same number of irrigations is applied, beginning about June 1 in ordinary seasons and repeating the operation at the end of 30-day intervals. As a rule, the orchards at Lewiston, Idaho, are watered three times, beginning about June 15. From two to four waterings suffice for fruit trees in the vicinity of Boulder, Colo. The last irrigation is given on or before September 5, so that the new wood may have a chance to mature before heavy freezes occur. In the Bitter Root Valley, Montana, young trees are irrigated earlier and oftener than mature trees. Trees in bearing are, as a rule, irrigated about July 15, August 10 and August 20 of each year. In San Diego county, Cal., citrus trees are watered six to eight times, and deciduous trees three to four times in a season.

Duty of Water in Orchard Irrigation.

The duty of water for 1 acre as fixed by water contracts varies all the way from one-fortieth to one four-hundredths of a cubic foot per second. In general, the most water is applied in districts that require the least. Wherever water is cheap and abundant the tendency seems to be to use large quantities, regardless of the requirements of the fruit trees. In Wyoming the duty of water is seldom less than at the rate of a cubic foot per second for 70 acres. In parts of southern California the same quantity of water not infrequently serves 400 acres, yet the amount required by the fruit trees of the latter locality is far in excess of that of the former.

In recent years the tendency all over the West is toward a more economical use of water, and even in localities where water for irrigation is still reasonably low in price it is rare that more than 2½ acre-feet per acre is applied in a season. This is the duty provided for in the contracts of the Bitter Root Valley Irrigation Company of Montana, which has 40,000 acres of fruit lands under ditch. Since, however, the water user is not entitled to receive more than one-half of an acre-foot per acre in any one calendar month, it is only when the growing season is long and dry that he requires the full amount.

In the vicinity of Boulder, Colo., the continuous flow of a

cubic foot per second for 105 days serves about 112 acres of all kinds of crops. This amount of water, if none were lost, would cover each acre to a depth of 1.9 feet. In other words, the duty of water is a trifle less than 2 acre-feet per acre.

In 1908, the depth of water used on a 21½-acre apple orchard at Wenatchee, Wash., was measured and found to be 23 inches. The trees were 7 years old and produced heavily. This orchard was watered five times, the first on May 13 and the last on September 23. In San Diego County, Cal., one miner's inch (one-fiftieth of a cubic foot per second) irrigates from 6 to 7 acres near the coast where the air is cool and evaporation low, but 20 miles or so inland the same amount of water is needed for about 4 acres.

On the sandy loam orchards of Orange County, Cal., it has been demonstrated that 2 acre-inches every sixty days is insufficient to keep bearing trees in good condition. The rainfall of this locality averages somewhat less than 12 inches per annum, but about 95 per cent of the total falls between November and May, inclusive.

The most reliable and in many ways the most valuable records pertaining to duty of water on orchards have been obtained by the water companies of Riverside county, Cal. Here more or less irrigation water is used every month of the year. Figure 25 is a graphic representation of the average amount of water used per month in a period of seven years by the Riverside Water Company, in irrigating about 9,000 acres, of which nearly 6,000 acres are planted to oranges and the balance to alfalfa. The figures given in the diagram represent depth in feet over the surface watered. In the following table is given the average duty of water per month in acre-feet per acre under the same system from December 1, 1901, to November 30, 1908, a period of seven years. The table also includes the average monthly rainfall at Riverside, Cal., for the same period, and adding the quantity of water applied in irrigation in any one month to the rainfall of that month gives the total moisture received by the soil.

Water used under Riverside Water Company's system (1901-1908.)

Month.	Average depth per acre. Feet.	Average rainfall. Feet.	Total water applied. Feet.
December	0.159	0.109	0.268
January	.123	.170	.293
February	.046	.190	.236
March	.078	.316	.394
April	.177	.068	.245
May	.291	.023	.314
June	.274	.003	.277
July	0.272	0.002	0.274
August	.269	.....	.269
September	.243	.015	.258
October	.189	.043	.232
November	.169	.073	.242
Total	2.29	1.01	3.30

MONDELL'S OPINION.

"I would see the boundaries of our forest reserves elastic. They should bend to the convenience of every man who would plow an acre, drop a seed, plant a tree or build a home. Whenever our reservations are fitted for settlement, they should be thrown open. Land laws should be made so that citizens may be encouraged and aided to become owners. The family altar raised upon debt-free land is liberty's hope and defense. The new nationalism shows a tendency to become the folly of the period. Every man who stands for the home is against the new nationalism."

A GREAT IRRIGATION PROJECT COMPLETED.

Land Commissioner Hornbeck of the Orient Railroad announces the great Imperial Irrigation project, begun under his management eighteen months ago, has been finished, and water from the Pecos River turned onto 25,000 acres of rich land. Two years ago this land was a portion of a 300,000 acre pasture. Commissioner Hornbeck persuaded capitalists allied with the Orient Railroad to buy 25,000 acres of the choicest land, and install a gravity flow irrigation system from the Pecos River. A natural reservoir site was enlarged into a basin two miles square and seventeen feet deep, a great dam thrown up, and sixty miles of canals for distribution of water built. This work cost $300,000, but the land coming under the irrigation system, formerly worth about $5.00 an acre as grazing land, now sells readily at $85.00 an acre, and will be worth $150 an acre this time next year, when under irrigation and cultivation. Irrigated land in this vicinity produces seven tons of alfalfa per season, and peaches and pears yield $500 an acre, upward, per annum. The land wealth of northern Pecos County, where the Imperial Irrigation project is located, has increased over five million dollars since the Orient Land Department began its activity and development there.

The Imperial Irrigation project being completed, you can go to Pecos Palisades land and farm it now. The reservoir is completed and the canal system is constructed to the immediate vicinity of this land. Two years ago the Imperial project was commenced and water-right contracts called for the completion of the system on August 1st, 1910. Fifteen days prior to that time contractors building the system completed their work. August 20th Pecos River flood waters were turned into the reservoir and farmers along Imperial canals began irrigating. These promises made by the Imperial Irrigation Company to its water-right holders were kept. Those who buy land now can see that water is ready, and if you wish to put your land into crops you can do so.

As the present selling price of Pecos Palisades lands with attached perpetual water-right, is $85 per acre, your attention is directed to a comparative tabulation of the leading irrigation projects of the United States, showing you the low cost of Pecos Palisades lands as compared with other irrigable lands, where projects are nearly completed, keeping in mind all the time that the Imperial Irrigation project is now completed as stated. Under the Yuma Irrigation project (California), now 60 per cent completed, land and water-rights cost $80 to $150 per acre; Strawberry Valley (Utah) project, 75 per cent completed, $100 to $250 per acre; Sunny Side project (Washington), being 72 per cent completed, $80 to $100 per acre; Umatilla project (Oregon), now 35 per cent completed, $110 to $260 per acre. In those uncompleted projects you are taking a risk as to when water will be ready for delivery. Under the Imperial project, Pecos Palisades, the irrigation system is 100 per cent complete, farmers are irrigating, land is being sold at $85 per acre, or cheaper than any of these projects, where hundreds of thousands of acres of land have been sold.

Why can you buy Pecos Palisades land at $85 an acre when land under other less completed projects is selling at $80 to $260? Because the railroad has not reached Pecos Palisades. But the Orient Railroad is building daily, closing its gap at both ends, and will soon cross the Pecos Valley. The road has 916 miles built and in operation, of a total of 1,600 miles to be built. The Orient shortens the distance 500 miles from the great central and southwestern states to the Pacific Ocean. Grading crews are working at numerous places along the Orient Survey between Fort Stockton and Mertzon, and Chief Engineer Colpitts says the Orient will be pushed into Fort Stockton without delay. This means quick railroad facilities in Pecos Palisades. Then you will see values rise. Land now selling at $85 should easily sell at $125 or more an acre.

You may doubt if irrigable land under canals at $85 per acre is low priced land. Land in irrigated districts doubles and trebles in value quickly, and $85 land ought really to be worth $150 an acre now. The following reports alone should be convincing:

The Twin Falls (Idaho) Commercial Club Secretary, Mr. Stoltz, writes: "Five years ago land was sold at $25 an acre, now worth $200 to $1,000 an acre." Roswell (N. M.) Commercial Club Secretary advises: "Orchard land here sells at $800 to $1,000 per acre." Only ten years ago Roswell (N. M.) land sold at $5 to $10 an acre. Yuma (Arizona) Abstract Company advises land under the Salt River project advanced from $40 four years ago to $200 an acre now. Sam Davis, of

the Reclamation Service, Truckee Carson project (Nevada) advised me land there was worth $300 to $500 an acre, an advance in value five hundred per cent per annum. The Pecos River Irrigation Company, at Carlsbad, reports land selling at $150 an acre, unimproved; $400, improved. At Orland, California, irrigated lands have advanced one hundred per cent in the last twelve months. Ernest Walter, an irrigation expert of Grand Valley, Colorado, visited Imperial project, Pecos Palisades, and wrote: "I sold my one-year-old Grand Valley orchard at $500 an acre and bought 160 acres from you, and I am sure that in a few years my Pecos land will be worth more than the orchard I just sold."

Can you any longer doubt the advisability of buying an irrigable farm under a completed project—early in its history—before development conditions have brought about the gigantic profits that are set out above? You may ask why these rich Pecos Palisades lands with a perpetual water-right under a completed irrigation system sell at $85 an acre, one-fifth cash, balance in four equal annual payments, when other projects maintain a price of $200 to $1,000 per acre. The answer is plain—the railroad is not there—the farmers are just beginning to plant crops. Although in the near vicinity rich fields of alfalfa and profit-bearing orchards abound, the Palisades tract is new. But another year will witness a great change. History proves that just as soon as an irrigation project is finished and the first crops are harvested, land values double and treble. With the coming of the Orient this next spring, values of Palisades land will increase.

If you locate in Palisades district, you will find good neighbors there now. The Orient Railroad desires high-class citizens making up the new districts along the line. "The Orient Railroad," says Wm. E. Curtis, the famous Chicago *Record-Herald* correspondent, "has so far cost twenty million dollars, and not one dollar has come from Wall Street. The Mexican Government contributed $3,555,000; the States of Chihuahua and Sinaloa, $800,000. The remainder of the money was raised in the United States and England by private subscription."

Prof. L. H. Bailey, of Cornell University, editor of *Country Life in America*, and head of Roosevelt's Farm Commission, appointed to investigate profits and social life on the farm, says: "The man who purchases good irrigated acres now is lucky above all others who have purchased land in America. The amount of irrigable land is very limited, and the man who buys this land now will be thanked by his children and his children's children."

Samuel Fortier, chief of irrigation investigations for the United States, says: "We do not know the exact area, but there is approximately 13,000,000 acres under irrigation now, with 50,000,000 acres susceptible of irrigation. Ninety-five per cent of acreage under irrigation now comes under private projects, although the government has twenty-five projects completed or nearly completed and has just borrowed twenty million dollars for reclamation of arid lands. The results of this stupendous labor of bringing water onto the land will be the greatest heritage we leave to a human race."

W. M. Reed, district engineer of the Reclamation Service, in talking to the El Paso *Herald*, September 25th, said: "Farming conditions at Carlsbad are the best I have ever seen." (The Carlsbad project is a short distance above Pecos Palisades and the only other reservoir project on the Pecos River.) "Carlsbad farmers have sold $80,000 worth of alfalfa seed and have unmarketed $100,000 worth more."

L. C. Draper, Fort Stockton, says: "One farmer at Fort Stockton on irrigated land this year made $120 per acre on forty acres of alfalfa. C. E. Boyle, a farmer in the Barstow Valley, from twenty-five acres of his first cutting of alfalfa netted $14 per acre."

Astounding crops grown in the vicinity of Pecos Palisades is of great encouragement to the new settlers. J. D. Wilcox, an Illinois farmer, who bought eighty acres, writes March 20th: "It would take $100 an acre to get my land now." Mr. Wilcox bought early, paying $60 per acre. He paid $15 down and refuses nearly three hundred per cent more profit than cash invested.

A field manager at Buenavista, Pecos Palisades district, says: "Everyone is active. Our people have bought for early delivery several thousand Keifer pear trees, several thousand grapes (malaga, cornishon, tokay and mission)." Ross Allison, resident engineer, reports over one thousand acres now being prepared for cultivation and irrigation. One syndicate will plant at least one thousand acres in alfalfa this winter. Three new town sites on the land now, there are churches and school facilities, telephone lines, daily mail service, many modern conveniences. Twenty thousand dollars are being expended now in clearing and planting the land. Despite the drouths in Texas and shortage of water under direct-from-the river irrigation systems, there is no reasonable fear about water under a reservoir such as Imperial. Stored water (taken from the river at flood times) is a great assurance of water for the crops when needed, hence activity in the Palisades district.

Illinois Delegation at the 18th National Irrigation Congress.

In selling the land, Commissioner Hornbeck has employed distinct methods. It is customary now in colonization work for capitalists to purchase large tracts of land at a net price and add large profits for the selling. But this land was sold direct from the owners to the purchasers. Applications have been passed with a view to getting good honest settlers—not speculators—and we have gone into irrigated districts and endeavored to get a desirable class of people.

The best talent possible was engaged to build the Imperial Irrigation system. Men experienced in the business are now employed to instruct the farmers who take up land under this irrigation system. The soil and water system will be studied carefully and scientifically by men who have been long in the service of reclamation projects and who understand application of water to arid soil, fruit and alfalfa planting and best methods of successful soil tillage under irrigation. These experts will deliver lectures to settlers in Pecos Palisades district and instruct them as to best methods.

Remember the irrigation movement is growing by leaps

(Continued on page 673.)

Notes on Practical Irrigation

D. H. Anderson

Plant Foods—Cereals—Forage Plants—Fruits—Vegetables—Root Crops.

Plants of every variety are very hearty feeders as a rule; in fact, if a plant be furnished with unlimited quantities of its proper food, and the environments of soil and climate are favorable, it will increase its bulk to enormous dimensions; the case is the same with fruits.

Sir Humphrey Davy introduced plants of miht into weak solutions of sugar, gum, jelly, etc., and found that they grew vigorously in all of them. He then watered separate spots of grass with the same several solutions, and with common water, and found that those watered with the solutions throve more luxuriantly than those treated with ordinary water. From this it may be reasonably inferred that different organic substances are taken into the circulation of plants and then converted by them into its own substance, or acts as food and nourishes the plant. Of course, it will be understood that by "plant foods" are meant whatever material tends to make the plant grow to maturity.

We have learned that plants absorb carbon in the shape of carbonic acid, and the part ammonia plays in the plant economy. Indeed, ammonia is actually present in the juices of many plants, for example: in beet roots, birch and maple trees, etc. In tobacco leaves and elder flowers it is combined with acid substances. It is also an element in the perfume of flowers, whence the value of barnyard manure to supply that element.

Nitric acid is invariably present in common, well known plants, in combination with potash, soda, lime, and magnesia (nitrates). It is always contained in the juices of the tobacco plant and the sunflower. The common nettle contains it, and it is present in barley in the form of nitrate of soda.

Like ammonia, nitric acid exerts a powerful influence on growing crops, whether of corn or grass. Applied to young grass or sprouting shoots of grain, it hastens and increases their growth and occasions a larger production of grain, and this grain is richer in gluten, and therefore more nutritious in quality.

As showing the power of a plant to select its own food: if a bean and a grain of wheat be grown side by side, the stalk of the wheat plant will contain silica and that of the bean none. The plant intelligence, or instinct, so to speak, knows what it wants or needs, and it takes what it requires, rejecting everything else. Plants have also the power to reject through their roots such substances as are unfit to contribute to their support, or which would be hurtful to them if retained in their system. Knobs, excrescences and exudations may often be seen on the roots, stems and even the leaves of plants, which many think are due to the ravages of some insect, but which are nothing more than the natural effort of the plant to get rid of some obnoxious or harmful substance in its system. When the plant's blood is out of order its nature attempts to cure it by forcing the dangerous substance or matter to the surface, as does the animal system under like circumstances.

Even the germinating seed is a chemical laboratory, inasmuch as it gives off acetic acid, or vinegar, which dissolves the inorganic material in its vicinity and returns with it in a condition to build up and nourish the plant.

The chemical compounds produced by the juices of all plants may be said to be innumerable. Most of them are in such small quantities that it would scarcely be worth while to consider them, but some are of a highly remedial quality, as quinine from Peruvian bark, morphine from the opium of the poppy, salicine from the willow, etc. All the cultivated grains and roots contain starch in large quantities, and the juices of trees, grasses and roots contain sugar in surprising quantities. The flour of grain contains sugar and two other substances in small quantities, namely: gluten and vegetable albumen, which are important nutritive substances. Sugar is also present in the juices of fruits, but is associated with various acids (sour) substances, which disappear altogether or are changed into sugar as the fruit ripens.

Woody Fiber, or Lignin.

To manufacture the foregoing chemical compounds nature requires a huge structure, an enormous space when compared with the product turned out. More than one has wondered why a monstrous oak should produce so ridiculously small a fruit as an acorn, and a weak pumpkin vine one so enormous. The philosopher in the fable complained of this irregularity of nature as he lay under an oak. But when a small acorn fell upon his head he changed his mind. Now, all this huge structure, the body of the plant, is as carefully manufactured as the delicate savory fruit, and out of the same ingredients, practically. The bulky part of the plant, the bone and sinew, so to speak, is the woody fiber, or lignin.

When a piece of wood is cut in small portions and cooked in water and alcohol until nothing more can be dissolved out of it, there remains a white, fibrous mass to which is given the name woody fiber, or lignin. It has neither taste nor smell, and it is insoluble. Strange to say, two of its chemical constituents are the same as water, being oxygen and hydrogen, with an equal quantity of carbon added.

Under the microscope this woody fiber appears to consist of what is called "cellular" matter, the true woody fiber, and a coating for strengthening purposes, called "incrusting" matter. This cellular matter is composed of oxygen and hydrogen in the proportions to form water, but it is difficult to separate them to determine the elementary construction, but we shall see that they demand a certain food and are intended for an important purpose.

The woody fiber sometimes constitutes a large proportion of the plant, and sometimes it is very small. In grasses and corn growing plants, it forms nearly one-half of the weight, but in roots and in plants used for food it is very small in the first stages of their growth. The following table gives the percentage of woody fiber in a few common plants while in a green state:

Name of plant.	Percent of woody fiber.	Water.
Pea stalks	10.33	80.0
White turnips	3.0	92.0
Common beet	3.0	86.0
Red clover	7.0	79.0
White clover	4.5	81.0
Alfalfa—in flower	9.0	73.0
Rye	1.0	68.0

Starch.

Next to woody fiber, starch is the most abundant product of vegetation. By whatever names the various kinds of starch are called: wheat starch, sago, potato starch, arrow root, tapioca, cassava, etc., they are all alike in their chemical constitution. They will keep for any length of time when dry and in a dry place, without any change. They are insoluble in cold water or alcohol, but dissolve readily in boiling water, giving a solution which becomes a jelly when cold. In a cold solution of iodine they assume a blue color.

The constituents of starch are carbon, oxygen and hydrogen, with less carbon and more oxygen than woody fiber and about the same quantity of hydrogen.

That starch constitutes a large portion of the weight of grains and roots usually grown for food the following table will show, one hundred pounds being the quantity upon which to base the percentage:

Name of plant.	Percentage of starch.
Wheat flour	39.77
Rye flour	50.61
Barley flour	67.70
Oatmeal	70.80
Rice	84.85
Corn	77.80
Buckwheat	52.0
Pea and bean meal	43.0
Potatoes	15.0

In roots abounding in sugar, as the beet, turnip and carrot, only two or three per centum of starch can be detected. It is found deposited among the woody fiber of certain trees, as in that of the willow and in the inner

bark of others, as the beech and the pine. This is the reason why the branch of a willow takes root and sprouts readily, and why the inner bark of certain trees are used for food in times of famine.

Gum.

Many varieties of gum occur in nature, all of them insoluble in alcohol, but become jelly in hot or cold water, and give a glutinous solution which may be used as an adhesive paste. Gum Arabic, or Senegal, is the best known. It is produced largely from the acacia, which grows in Asia, Africa, California and in the warm regions of America generally. It exudes from the twigs and stems of these trees and forms round, transparent drops, or "tears." Many of our fruit trees also produce it in smaller quantities, such as the apple, plum and cherry. It is present in the malva, or althea, and in the common marshmallow, and exists in flax, rape, and numerous other seeds, which, treated with boiling water, give mucilaginous solutions.

All the vegetable gums possess the same chemical constituents of carbon, oxygen and hydrogen, in nearly the same proportions as woody fiber and starch.

Sugars.

All sugars may be classified according to four prominent varieties: Cane, grape, manna and glucose.

First—Cane sugar is so called from the sweet substance obtained from sugar cane. It is also found in many trees, plants and roots. The juice of the maple tree may be boiled down into sugar, and in the Caucasus the juice of the walnut tree is extracted for the same purpose.

It is also present in the juice of the beet, turnip and carrot. Sugar beet cultivation is assuming enormous proportions in the United States, as well as in Europe. Carrot juice is boiled down into a tasteless jelly and when flavored with any fruit flavors passes for genuine fruit jelly.

It is further present in the unripe grains of corn, at the base of the flowers of many grasses and in clovers when in blossom.

Pure cane sugar, free from water, consists of the following elements, estimated in percentages:

Carbon, 44.92; oxygen, 48.97; hydrogen, 6.11; almost identical with starch.

Second—Grape sugar. This sugar is so called from a peculiar species of sugar existing in the dried grape or raisin, which has the appearance of small, round or grape-shaped grains. It gives sweetness to the gooseberry, current, apple, pear, plum, apricot, and most other fruits. It is also the sweet substance of the chestnut, of the brewer's wort, and of all fermented liquors, and it is the sugar of honey when the latter thickens and granulates, or "sugars."

It is less soluble in water than cane sugar, and less sweet, two parts of cane sugar imparting as much sweetness as five parts of grape sugar, at which ratio forty pounds of cane sugar would equal 100 pounds of grape sugar. Its chemical constituents are, in percentages: Carbon, 40.47; oxygen, 52.94; hydrogen, 6.59. Likewise nearly the same as starch.

As a test to distinguish cane sugar from grape sugar: Heat a solution of both and put in each a little caustic potash. The cane sugar will be unchanged, while the grape sugar will be blackened and precipitated to the bottom of the vessel.

Manna Sugar, Etc.

Manna sugar occurs less abundantly in the juices of certain plants than cane or grape sugar. It exudes from a species of ash tree which grows in Sicily, Italy, Syria and Arabia. It is the product and main portion of an edible lichen, or moss, very common in Asia Minor. This curious lichen is found in small, round, dark colored masses, from the size of a pea to that of a hazel nut or filbert, and is speckled with small white spots. The wind carries it everywhere, and it takes root wherever it happens to fall. It can only be gathered early in the morning as it soon decomposes, or corrupts. The natives gather it from the ground in large quantities and make it into bread. This is said to be what constituted the "rain of manna," which fed the Israelites during their wanderings in the desert, and it derives its name from that circumstance.

Manna sugar is found in the juice of the larch tree and in the comon garden celery. In the mushroom a colorless variety is found. To add two other varieties of sugar, the black sugar of liquorice root and sugar of milk may be mentioned.

Glucose.

The name of this sugar means "sweet," a sweet principle, or element. It occurs in nature very abundantly, as in ripe grapes, and in honey, and it is manufactured in large quantities from starch by the action of heat and acids. It is only about one-half as sweet as cane sugar. It is sometimes called "dextrose," "grape sugar," and "starch sugar." What is known to the trade as "glucose," is the uncrystallizable residue in the manufacture of glucose proper, and it contains some dextrose, maltose, dextrine, etc. Its profusion and ease of manufacture makes it a cheap adulteration for syrups, in beers, and in all forms of cheap candies. The test for it is the same as that given to distinguish between cane and grape sugar.

All the elements in the foregoing sugars are similar in their chemical constitution, and what is still more remarkable about them, is the fact that they may be transformed one into the other, that is: Woody fiber may be changed into starch by heat, sulphuric acid, or caustic potash; the starch thus produced may be further transformed, first, into gum, and then into grape sugar by the prolonged action of dilute sulphuric acid and moderate heat. When cane sugar is digested (heated) with dilute sulphuric acid, tartaric acid (acid of grapes), and other vegetable acids, it is rapidly converted into grape sugar. When sugar occurs in the juice of any plant or fruit, in connection with an acid, it is always grape sugar, because cane sugar can not exist in combination with an acid, but is gradually transformed into grape sugar. This is the reason why fruits ferment so readily, and why, even when preserved with cane sugar, the latter is slowly changed into grape sugar and then fermentation ensues, and the preserved fruit "spoils."

Gluten, Vegetable Albumen and Diastase.

These substances are the nitrogenous elements in plants.

Scene on Line of Western Pacific Railway (Feather River).

Gluten is a soft, tenacious and elastic substance, which can be drawn out into long strings. It has little color, taste, or smell, and is scarcely diminished in bulk by washing either in hot or cold water. It is a product of grain flour, left after washing dough in a fine sieve, and allowing the milky, soluble substance to pass off. The percentage of gluten in various grains is as follows:

Wheat	8 to 35 per centum.
Rye	9 to 13 per centum.
Barley	3 to 6 per centum.
Oats	2 to 5 per centum.

Dried in the air it diminishes in bulk, and hardens into a brittle, transparent yellow substance resembling corn, or glue. It is insoluble in water, but dissolves readily in vinegar, alcohol, and in solutions of caustic potash, or common soda.

Vegetable albumen is practically the same as the white of eggs. It has neither color, taste, nor smell, is insoluble in water or alcohol, but dissolves in vinegar, and in caustic potash, and soda. When dry it is brittle and opaque. It is found in the seeds of plants in small quantities, and in grain in the following percentages:

Wheat	.75 to 1.50
Rye	2.0 to 3.75
Barley	.10 to .50
Oats	.20 to .50

It occurs largely, moreover, in the fresh juices of plants, in cabbage leaves, turnips and numerous others. When these juices are heated, the albumen coagulates and is readily separated.

Gluten and vegetable albumen are as closely related to each other as sugar and starch They consist of the same elements united in the same proportions, and are capable of similar mutual transformations. The following table will show the percentages in which the reader will notice that nitrogen is an element which does not exist in starch or sugar:

Carbon	54.76
Oxygen	20.06
Hydrogen	7.06
Nitrogen	18.12

When exposed to the air in a moist state both these substances decompose and emit a very disagreeable odor, giving off, among other compounds, ammonia and vinegar. Both of them exercise an important influence over the nourishing properties of the different kinds of foods, as we shall see in a subsequent chapter.

Diastase.

This substance may be manufactured from newly malted barley, or from any grain or tuber when germinated. It is not found in the seed, but is manufactured during the process of germination by the seed itself, or its decomposition, and it remains with the seed until the first true leaves of the plant have expanded, and then it disappears. Its functions, therefore, are to aid in the sprouting of the seed, and that accomplished, and there being no further use for it, it disappears. The reason for this is as follows:

Diastase possesses the power of converting starch into grape sugar. First, it forms out of starch a gummy substance known as dextrine, in common use as adhesive paste, and then converts it into grape sugar. Now, the starch in the seed is the food of the future germ, prepared and ready to minister to its wants whenever heat and moisture come together to awaken it into life. But starch is insoluble in water and could not, therefore, accompany the fluid sap when it begins to circulate. For which reason, nature forms diastase at the point when the germ first issues, or sprouts from its bed of food. There it transforms the starch into soluble sugar, so that the young vessels can take it up and carry it to the point of growth. When the little plant is able to provide for itself, and select its own food out of the soil and air, it becomes independent of the diastase and the latter is no longer wanted. Weaning a child will give the reader the idea.

Vegetable Acids.

There is another class of compound substances which play an important part in the development of plant foods and the perfection of growth. They are known as the vegetable acids, and it is due to them that plants possess a taste and flavor, every plant having its own peculiar acid. They are usually classified into five species and enter into combination with all of the substances heretofore referred to. They are:

Acetic acid (vinegar), tartaric acid (acid of wine), citric acid (acid of lemons), malic acid (acid of apples), and oxalic acid (acid of sorrel). Acetic acid is the most extensively diffused and the most largely produced of all the organic acids. It is formed wherever there is a natural or artificial fermentation of vegetable substances. It easily dissolves lime, magnesia, alumina, and other mineral substances, forming salts known as "acetate," which are all soluble in water, and may, therefore, be absorbed by the root pores of plants. It is an acid common in everything, and may be manufactured from wood, alcohol, cane sugar and from the juice of apples, or by any vegetable fermentation, the process of fermentation throwing off carbonic acid and forming vinegar.

Tartaric acid finds lodgment in a variety of plants. The grape and the tamarind owe their sourness to it, and it exists also in the mulberry, berries of the sumach, in the sorrels, and in the roots of the dandelion. It is deposited on the sides of wine vats, and when purified and compounded with potash, it becomes the familiar "cream of tartar," which is known to every housewife. In the grape it is converted into sugar during the ripening of the fruit.

Citric acid gives sourness to the lemon, lime, orange, grape fruit, shaddock and other members of the citrus family. It is the acid in the cranberry, and in numerous small fruits such as the huckleberry, wild cherry, currant, gooseberry, strawberry, and the fruit of the hawthorn. In combination with lime, it exists in the tubers, and with potash, it is found in the Jerusalem artichoke

Malic acid is the chief acid in apples, peaches, plums, pears, elderberries, the fruit of the mountain ash. It is combined with citric acid in the small fruits above mentioned, and in the grape and American agave it is associated with tartaric acid. It has exactly the same chemical constitution as citric acid, and the two bear the same relation to each other as starch, gum and sugar. They undergo numerous transformations in the interior of plants, and are the cause of the various flavors possessed by fruit and vegetables.

Oxalic acid has poisonous qualities, but an agreeable taste. It occurs in combination with potash in the sorrels, in garden rhubarb, and in the juices of many lichens, or mosses. Those mosses which cover the sides of rocks and the trunks of trees sometimes contain half their weight of this acid in combination with lime.

This chapter is, of course, one step farther in advance of the one immediately preceding, and the facts stated are intended to lead on up to a complete, practical knowledge of the forces of nature operating in the soil and within the plant to attain perfection. Nothing but the bare essentials, the mere outlines, have been given so far; to attempt to enter into all the details would be to write an entire volume, the reading of which might prove tiresome and unproductive of anything practical. All that it is desired to do in these preliminary chapters is to furnish the reader with sufficient elementary knowledge to enable him to go farther on his own account and to infer what the soil needs for the cultivation of plants; how that soil is to be cultivated, and how the element of water is to be applied to it in order to increase its productiveness and his profit. This is the true preliminary to irrigation, as we imagine, for it would convey no information to suggest the pouring of water on the oil, and drenching plants and crops with it, unless the intelligence is prepared to understand why that should be done, and all the details and consequences laid before the reason and common sense.

So far, the reader ought to have a comparatively clear idea of the chemical constitutions of the substances which enter into the soil, and from the soil into the plants, but there still remains the question: How do the substances necessary to plant life get into the condition of plant food? This question will be answered in a future article.

Experiments in Supplemental Irrigation With Small Water Supplies at Cheyenne, Wyo., in 1909.

The Office of Experiment Stations has maintained since 1905 at Cheyenne and Newcastle, Wyo., and Eads, Colo., experimental farms for the purpose of testing the value of irrigating small areas in connection with the farming of larger areas without irrigation in the semi-arid region where water for the irrigation of any large part of the arable land is not available. The results at Cheyenne and Newcastle for the seasons 1905 to 1908 have been published in Circular 92 of this office. The present report gives the results at the Cheyenne farm in 1909. This is the first season that satisfactory results have been secured. Heretofore the water system was not in good working order, while destructive hailstorms, occurring when crops were maturing, left no measure by which to test the merits of the different systems used.

Although the spring of 1909 was unusually late and the planting of some crops was delayed, the crops were not greatly retarded, and hailstorms did not seriously injure them. A careful record of all operations and yields was kept by the irrigation farmer in charge of the experiment work.

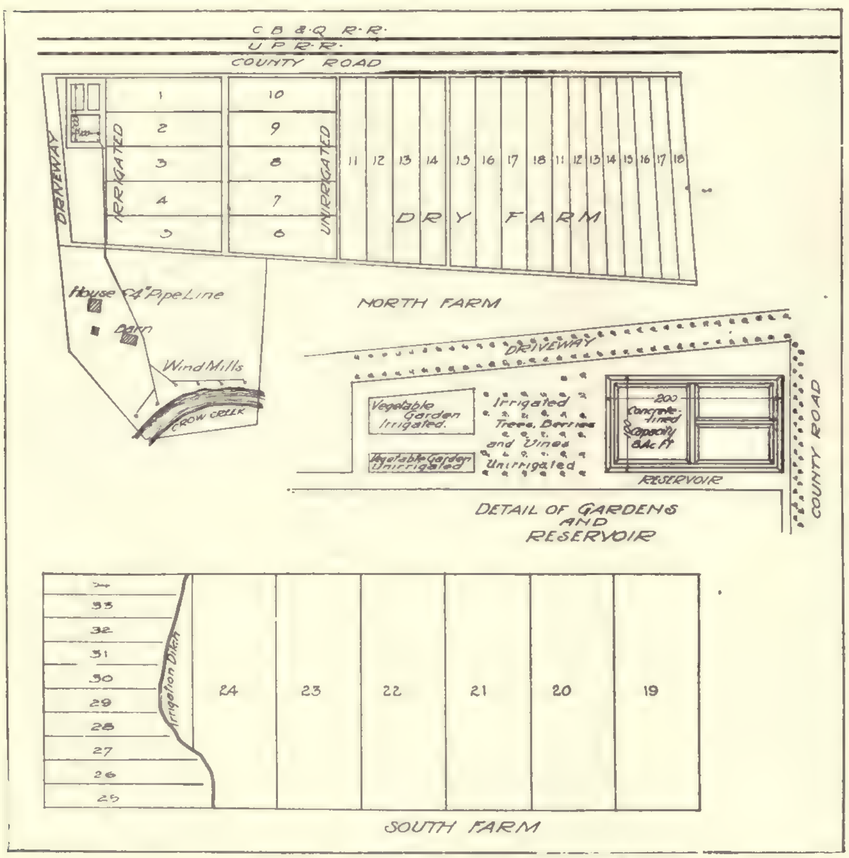


Fig. 1.

The accompanying map (fig. 1) shows the plats referred to and will assist the reader in following the account of the work.

Full Irrigation v. No Irrigation.

Plats 1, 2, 3, 4 and 5 were irrigated with what was considered sufficient water to produce the best results. Plats 6, 7, 8, 9 and 10 were unirrigated. All the plats from 1 to 10 received the same seeding, tillage and treatment with the exception of water, and as far as could be judged, the character of the soil in all plats was the same. The area of each plat is practically 1 acre

Barley.—Plats 1 and 10 were seeded to Beardless Hull-less barley, and the following shows the results:

YIELDS OF IRRIGATED AND UNIRRIGATED BARLEY.

Plat.	Treatment.	Amount water applied, inches.	Amount rainfall in inches, Jan. 1 to Aug. 5.*	Yield, in bushels.	Remarks.
1	Irrigated	6.6	11.89	42½	Excellent grade.
10	Unirrigated ...	None.	11.89	16½	

*Date barley was harvested.

This shows a gain of 26 bushels to the acre in favor of irrigation.

Field peas.—Plats 2 and 9 were seeded to field peas, but when they were fairly above the ground a hailstorm damaged them to such an extent that it was thought advisable to plow the plats and seed to millet as a catch crop, and at the same time prevent the growth of weeds and furnish some forage for the horses. Water to the depth of 4.2 inches was applied to plat 2 at a time when the crop required moisture. Sixty-nine days after seeding there was taken from plat 2 2,944 pounds of very good millet hay. Plat 9 was harvested at the same time and gave a return of 737 pounds, a gain of 2,207 pounds in favor of the irrigated plat.

Alfalfa.—Plats 3 and 8 were planted to alfalfa in 1908. Two crops were taken from each of these plats during the season of 1909. The yield on plat 3, which received 10.8 inches of water from irrigation, was almost 5,000 pounds. Plat 8 yielded 2,100 pounds, showing a difference of 2,900 pounds in favor of plat 3. Both plats were damaged by a hailstorm in the early stages of growth. It will be seen from this that a larger amount of water was used than on other crops, but to get the greatest returns from alfalfa water should be applied abundantly, and especially is this true if there is a porous, gravelly subsoil. While it is true that the roots have a natural tendency to penetrate deeply, it is a mistake to depend on this deep rooting alone for moisture, as shown by the large increase in yield on the irrigated plat.

Wheat.—Plats 4 and 7 were planted to Turkey Red winter wheat. Plat 4, to which water was applied 7.38 inches in depth, yielded 38½ bushels of wheat, weighing 59½ pounds to the bushel, showing well-filled grain. From plat 7 no returns were made, all the plants being completely winterkilled. Undoubtedly the cause of such complete failure was the lack of moisture when needed. In 1908 the experience with winter wheat was the same. The irrigated acre yielded 33 bushels of prime wheat while the unirrigated failed as completely as it did this year. These plats are illustrative of what is called continuous cropping, and the results seem to indicate that this practice is a failure so far as winter wheat is concerned.

Potatoes.—Plats 5 and 6 were planted to potatoes. Plat 5, with an application of 8.57 inches of water, yielded 140 bushels of potatoes, all sizes, and of excellent quality. Plat 6, which was unirrigated, yielded 63 bushels of potatoes, all sizes, and of as good a quality as the irrigated crop, the only difference being in the yield, which was 77 bushels greater on the irrigated plat. The wheat mentioned above as a failure in 1908 was planted on plat 6, consequently the plat was followed during the season, and this undoubtedly helped the unirrigated potato crop. Scab made its appearance in both plats, being a little more pronounced in plat 6, but nothing really serious.

Summer Fallowing.

Plats 11 to 18, inclusive, are in the part of the farm devoted to experiments in summer fallowing.

Field peas.—Plat 11 was fallowed during 1908 and seeded to field peas in the spring of 1909, but was so damaged by the hailstorm referred to that it was reseeded to millet, which gave a return of 1,980 pounds on an area of 0.97 acre. Plat

12, having an equal area, was also planted to field peas and re-planted to millet, with a yield of 1,920 pounds of good hay. The average for the two plats was 1,950 pounds, or 2,031 pounds per acre.

Comparing this with the yield given above gives the following: Yield from irrigated land, 2,944 pounds per acre; yield from summer-fallowed land, 2,031 pounds per acre; and yield from land continuously cropped and not irrigated, 737 pounds.

Barley.—Plat 13 was seeded to Beardless Hullless barley in rows 8 inches apart and produced a yield of 8 bushels from the thresher from an area of 0.8 acre. Plat 14, having the same area, was seeded to the same kind of barley, but in rows 16 inches apart, and was cultivated and gave a yield of 15 bushels, or 10 and 18.8 bushels per acre, respectively. The irrigated plat yielded 42.5 bushels per acre, while the continuously cropped and not irrigated plat yielded 16.5 bushels per acre.

Potatoes.—Plat 15, 0.79 acre, was planted to potatoes in rows 36 inches apart and the seed dropped 17 inches apart in rows. The yield was 40 bushels of all sizes and very scabby, and hard to sell even at greatly reduced prices on that account. Plat 16 was planted to potatoes in rows 46 inches apart and seed dropped 17 inches apart in the rows. The yield was 59 bushels from the same area as plat 15, but like the product on the first plat the potatoes were very scabby. The seed on part of each plat was treated with corrosive sublimate and formaldehyde, but no difference between potatoes from treated and untreated seed could be noticed. Plat 5, which was irrigated, yielded 140 bushels per acre.

Wheat.—Plat 17, having an area of 0.79 acre, was planted to winter wheat in 16-inch rows and cultivated. It was winterkilled to a serious extent and yielded from the thresher but 5½ bushels of very poor quality of wheat, weighing but 55 pounds to the bushel. Plat 18, of the same area, was seeded the same as 17, but in rows 8 inches apart, with no better results, as it was badly winterkilled and yielded but 5 bushels. About one-third of these two plats is so steep and badly situated and have such rocky, gravelly soil as to make them unfit for cultivation, and this accounts, in a great measure, for the small returns from the above plats.

Fall or Spring Irrigation.

Plats 19, 20, 21, 22, 23, and 24 are 5-acre plats and are situated on what is called the south farm and receive fall or spring watering only.

In the fall of 1908 water was applied to a depth of about 3 feet over the entire six plats. In the spring of 1909 the south half of the plats again received water to the depth of 2 feet. The soil of this portion is very gravelly in character and the moisture was not retained to the same extent as in the northern half.

Alfalfa.—Plat 19 was planted to alfalfa in 1906, two crops being harvested in 1909. The first cutting yielded 7½ tons and the second 2¾ tons, making a total of 10¼ tons for the season, slightly over two tons per acre. The quality of the hay was very good. The crop, in its early stages, was somewhat damaged by hail or a greater yield would have been produced. It will be noted that there is a great difference in yeld between the first and second crops. This is due to the fact that after the first crop is harvested the remainder of the season was unusually dry. But even so, note the decided advantage that fall watering has over dry farming. In comparing the above yield of 4,120 pounds to the acre with plat 8, where the yield was but 2,100 pounds to the acre, a difference of 2,020 pounds is shown in favor of the plat which was irrigated in the fall and spring.

Barley.—Plat 20 was seeded to Beardless Hullless barley, from which was harvested 131 bushels of first-class grain which weighed 63 pounds to the bushel from the thresher. According to the standard weight of barley the yield was 34½ bushels to the acre. Plat 10, which was exclusively dry farmed, yielded 16½ bushels to the acre, showing an increase of 18 bushels to the acre in favor of the crop receiving fall watering. These comparisons show the great advantage of fall or spring watering over dry farming, notwithstanding the fact that the precipitation during the year was 3.5 inches above the normal. Large quantities of water which might be used in this way run to waste in the fall and spring months, and this might be used to advantage, as it has been at Cheyenne, and thus supplement dry farming.

Wheat.—Plat 21 was seeded to Defiance wheat and yielded rather poorly, only 8 bushels to the acre, and grain of inferior quality. Two reasons might be assigned for such a small production. As has been stated before, for the past two seasons severe hailstorms seriously damaged the crops, and especially was this true in 1908, when the wheat was at its ripening stage. No doubt the strongest of the grain was lost, making the seed used in 1909 of an inferior grade and not possessed with the vigor of reproduction. Then, again, the Defiance wheat does not withstand drought as well as durum wheat or barley, while hail injures it more. This may, in some measure, account for the light yield. The crops on either side of this plat were very satisfactory.

Oats.—Plat 22 was seeded to oats. Two and one-half acres was seeded with Swedish select oats, which gave a yield of 86 bushels, or 35 bushels to the acre, and the quality was very good. The other 2½ acres was seeded to Kherson oats which yielded 98 bushels, or 39 bushels to the acre. The average yield for the 5 acres was, therefore, 37 bushels to the acre. It has been found that Kherson oats are especially well adapted to this section. Where irrigation can be applied they ripen very early and the most of the growth is completed before the dry season sets in.

Potatoes.—Plat 23 was planted to potatoes and yielded rather poorly from some cause which was not determined. The plat was planted, cultivated, and kept free from weeds, and the condition or appearance of the plants gave every evidence of producing well. However, the period from June 20 to the early part of September was very dry, and the moisture after that time, although abundant, was not beneficial to the crop. There was a yield of but 42 bushels to the acre, of all sizes, and there were many scabby potatoes among the treated rows as well as the untreated.

Durum wheat.—Plat 24 was planted to durum wheat from which was threshed 84 bushels of first-class grain. This is almost 17 bushels to the acre. From the experience at Cheyenne it seems that the durum wheat will withstand drought much better than any other wheat tried, and it also appears to suffer less from hail than the beardless variety.

Dry Farming.

Alfalfa.—Plats 25 to 29, inclusive, were planted to alfalfa and exclusively dry farmed. There was but one light cutting, and as the crop over the several plats appeared to be much the same, a portion was measured and weighed and showed a yield of about 1,000 pounds to the acre. On plats 28 and 29 the stand was very poor and the plants had the appearance, to some extent, of being winterkilled. The growth was so small during the latter part of the season that no second cutting was made. Compare this with plat 3, which was irrigated and yielded 5,000 pounds to the acre, a difference of 4,000 pounds to the acre, and with plat 19, which was fall irrigated and where the yield was 4,125 pounds to the acre, a difference in favor of fall irrigation of 3,125 pounds. From the foregoing it would seem that alfalfa can not be recommended as a dry-farm crop for this section. This is further emphasized by the efforts of others in this section to secure a remunerative crop of alfalfa by the dry-farm system.

Potatoes.—Plats 30 and 31 were planted to potatoes. These plats had been fallowed in 1908 and the land was in fine condition as a seed bed in the spring of 1909. From these two plats was harvested 72 bushels of potatoes, or about 61 bushels to the acre, of all sizes and of very good quality. This was the first time potatoes were grown on this land and little scab was found.

Plat 32 was seeded to slender wheat grass in 1907 and has produced two crops. This season's yield was 2,440 pounds to the acre. From the experience of the past two seasons this grass can be recommended highly as a dry-farm crop, provided the same soil tillage be given as on the portion where this experiment was made. Plat 33 was seeded to brome grass at the same time the slender wheat grass was sown and two crops have been harvested with an average yield of 2,400 pounds to the acre, the hay being of very fine quality. The land on which the slender wheat grass and brome grass were grown was fallowed the previous year, 1906, and was kept free from weeds, so that the soil was in excellent tilth. The hay has been fed to work horses and, so far as can be judged, is superior to alfalfa for horse feed.

Plat 34 was planted to durum wheat in the spring of 1909. This plat was fallowed during 1908, and in the spring of 1909 the soil was in fine tilth. Eleven and one-half bushels were harvested from this plat, which measured one acre. Particular attention is called to this plat in comparison with plat 24, which was fall watered and shows a gain of 5 bushels to the acre. When it is considered that plat 24 was cropped in 1908, while plat 34 was fallowed during the same period, it can

readily be seen that there is a large advantage in fall or winter irrigation.

Garden Crops With and Without Irrigation.

In connection with the thirty-four plats just reported on, experiments have been carried on in the raising of garden produce with irrigation and without it. The experimental work here shows that water is absolutely essential to a productive garden; in fact, such products require a great deal more water than field crops. The majority of the plants are tender and do not root deeply, and to promote good growth they must be supplied with ample food, and to make this available abundant moisture is required. The irrigated garden was the admiration of all who visited it, and, considering the elevation of 6,000 feet, the results were marvelous. That portion of the garden which was not irrigated had similar soil and tillage; in fact, all conditions were the same, with the exception of the application of water. The returns were so poor on the unirrigated portion as not to justify the expenditure for labor and seed. It will be seen, therefore, that to have a successful garden in this section irrigation must be practiced.

Trees and Fruits.

The growing of shade trees, or windbreaks, and fruit trees has been a part of the experimental work here for several years past. It will be seen from the map that these are located where there is no shelter, and with these unfavorable conditions the growing of trees has not been a success. Three varieties of apple trees have been tried, viz., Wealthy, Winesap, and Jonathan—five trees of each. These were planted in the spring of 1908 and by the following spring only one Winesap, one Jonathan and four Wealthy trees were alive, the loss being due, undoubtedly, to exposure. From former and present experience, the Wealthy apple is recommended as being able to withstand adverse conditions better than other varieties, and unless there is a natural or artificial shelter it does not seem advisable to plant any other kind in this region. Of the plum and cherry trees planted in 1908 about half died during the following winter. However, the encouragement from those that did live was enough to try again, and all the dead trees were replaced in the spring of 1909 and made very good growth during the summer. Experiments with shade and forest trees have been much the same, the broad-leaf cottonwood being the only hardy survivor. Lombard and Carolina poplars were planted at the same time, but all have died with the exception of five, which have done fairly well. The poplars have often been tried here, but so far they have not been a success. The broad-leaf cottonwood has made a wonderful growth and the foliage and general appearance have been much admired. The box elder also does well, but until a windbreak has been secured the other varieties do not do well.

Strawberries, blackberries, raspberries, grapes and currants have alike been unsuccessful in bearing fruit. During the past season the strawberries made a vigorous growth, but were practically unfruitful. This was probably due to the fact that it takes such plants some time to become inured to strange conditions. It will probably take several seasons to test fairly the growing of strawberries. Raspberries and blackberries winterkill very easily, though laid down and covered with earth, which is usually deemed sufficient. Currants seem to withstand the winter very well without any protection, but the growth is very slow. Undoubtedly the cold north winds of this section are the most serious drawback to the growing of these plants.

Windmills.

Reference should be made here to the windmills in operation at the experiment farm. During the past season they have been in excellent working order, not a dollar having been spent on them for repairs, and the maintenance cost confined to the necessary expense for oil. Another report deals with these windmills, but it is not out of place here to speak of their usefulness in providing a water supply in connection with extensive dry farming. The small cost of installing and maintaining a reliable windmill places them within reach of the average farmer. A storage reservoir, where water is used for irrigation, is quite essential and can be constructed at a small expense. In many localities puddling alone is all that is necessary to prevent seepage, but it is also very true that some soils will not respond to this treatment, and then it becomes necessary to line the reservoir. Under some conditions a cement lining is necessary, but even with this additional expense the farmer depending on pumped water will find it a

(Continued on page 673.)

The Lure of an Oregon Orchard

By Irene Finley.

Nature cares for a man if he lives the life she intended him to live. She expects him to live in the country, not in the crowded city. The city has its economic importance, but from nature's standpoint it is a nuisance. A man needs a wife, children, friends and a home with one or more acres of ground.

As Dallas Lore Sharp says, the troubles of living in the city is that a person hires it done. He hires the baker the milkman, the grocer and the dump-cart to haul off the remains. He eats, he works a little and he sleeps, but he does not live at all. His living is all done for him. He gets the pumpkin pie the baker makes, but it tastes of tin. He gets a can or bottle of milk, but he never sees the cow even when he gets up early. He gets his vegetables all nicely tied in bundles with the dirt washed off so he has no indication whether they were grown or made by some machine. He gets his wood out of a hole in the wall, but he never gets the vigorous exercise of splitting it to keep his muscles from decaying. He gets his fruit all nicely boxed, accompanied by a colored label. This label is an important part of city life. It is the commercial way of making things taste of the country. It is

Rogue River Valley, Oregon, a Country of Orchard Homes.

a reminder to the man in the city that he lives without roots and does not even touch the earth to draw from the real source of power.

Trying to make a home in a big city is really a very serious problem. In a modern city flat, one is dumped in by a hoisting machine at night and dropped out again in the morning. He has a floor over his head and one under his feet. He lives in a good burrow, but not a home. He can't make a home of a place three flights up with nothing but a wooden back yard and a ladder to climb down. He has no garden to hoe, no fruit to pick, no chickens to feed, no cow to milk. His children are of most importance. Flats are not made for children. The janitor doesn't allow them. But even if he did, what's the use of having children if you can't run and romp with them and yell and have a good time?

Some people are not satisfied except with a hired living. Others are by circumstances held captive in the city. In their meditative moments they see a low rambling house with its orchard and garden, they see cows in the pasture and hay fields and beyond they see the sunlight and shadow lying on the distant hills. These visions come every day. These are their "castles in Spain."

When one can own a few acres of land beyond the city borders surrounded by good neighbors and modern conveniences and earn from $500 to $1,000 an acre each year, it means the solving of an important economical

question. It means the time has come when a lover of outdoor life does not have to halt in doubt on the threshold, but can change from the city to the country.

Life in the Oregon country means that I can raise my two children in a country atmosphere where they have plenty of room to run and play, where they can learn how to keep their own garden, care for their own chickens, eat the fruit they raise with their own hands, and with these have the privileges of a good graded school with good companions.

Our country of today is not the country of years ago. Our nearest neighbor is not a mile away. Communities are more closely knit than in New England. In many places one can hardly tell where the town ends and the country begins. Our homes are not devoid of conveniences, for do we not have the best water through our houses and gardens, electric lights, telephones and automobiles, the grocer and the mailman at our door once a day and a trolley line within half a mile? On still evenings I hear the rumbling and crunching of steel and the distant shriek of the whistle as the car coasts down the long slope in the swale. I hope the noisy monster never comes nearer.

Our apple valleys are satisfactory places for the education of children. The advantages offered have drawn a high type of citizenship, a class of people who seek a healthy social and educational atmosphere. The smallest apple valley in our state is Hood River with a population of eight thousand people. Here in a town of three thousand, is a University Club of 110 members. At a recent banquet, there were more than 70 graduates of the principal colleges of the United States; Harvard, Cornell, Princeton, and other leading institutions are all represented among the apple growers of Hood River.

In real education, Oregon is not behind other states of the Union. Not a single state east of the Mississippi has as few illiterates as Oregon. We have less than one per cent. The West grows men and women of large conception. Our boys and girls cannot escape the influence of environment. Someone has said the westener is not so cultured as the eastener, but he is better educated.

In matters of public importance, especially in politics, there is probably more practical intelligence applied in Oregon than in any state in the Union. The Oregon legislature is ruled by the people who elect and who pay its wages. If, influenced by bosses, it refuses to pass a bill, the people themselves pass it through the initiative. If it sells out to a corporation, the people apply the brake by calling a referendum. By these two devices the Oregon legislature has come to be merely a quiet meeting of business men who attend to the things they are hired for and go back home. In many places the election of a United States senator by the legislature is a grand chance for bribery and corruption. In Oregon the people say by ballot whom they want to represent them in Washington and the legislature chooses this man.

If you think apple growing has not its lure, you ought to own a few trees in Oregon. I have listened to the cackle of my hens when every cackle meant a nickel. I have milked my cows and churned when butter was forty-five cents a pound. But this is not like walking out under the trees when the limbs are heavy with fruit and each apple is worth from two to five cents, not in New York but cash in hand the minute they are delivered at the depot. Think of walking under your trees and feeling your pears when each one is worth from five to ten cents!

A farmer in the East or Middle West who spends many a back-aching day in an effort to make his land net $50 an acre is incredulous when he hears of land that will produce from $500 to $1,500 an acre. But the story of these big profits is a simple one. With the barrier of big freight rates in front of him and a haul across the Rocky mountains and the long stretch of plains, it meant at the outset that an Oregon apple grower had to grow something better than any other place between the Atlantic and the Pacific. His hope from the beginning was to produce a sort of a de luxe edition from his trees.

The two watchwords have been quality and cooperation. The press has preached quality, the managers have urged quality, and quality and cooperation have been the themes at every meeting of the growers and wherever there has been an exhibition of fruit. An apple tree will produce more boxes of fancy apples than culls, and a tree loaded with extra fine apples will bring more than a tree full of cider apples. There can never be an over production of high grade fruit.

The fruit growers united and with all the marketing in the hands of a trained and competent manager, the orchard owners have nothing else to do but pet and coax their trees. These are in turn bringing them profits never before equaled in the history of fruit growing in America.

The books of the fruit growers' associations show some mighty interesting records. I saw figures that made me sit up and wonder how—"pear-alysis and apple-plexy figures" the grower said. On September 30, 1907, a carload of Comice pears belonging to Mr. C. H. Lewis, who owns the Bear Creek Orchards in the Rogue River Valley, sold at auction in New York City for $4,622.80, the highest price ever received for a carload of fresh fruit. Most of these pears were shipped in half boxes, that is, each containing twenty-five pounds or about half a bushel. These sold for $4.10. Out of this the grower had to pay 46c for commissions, 45c for freight and refrigeration and 59c for picking and packing. This left a net profit of $2.60 per half box. Another smaller shipment of these pears averaged $4.60 per half box, leaving a net profit of $3.10. Another carload from Medford sold for $4,558. In January, 1909, a shipment of Comice pears from the same orchard was sold in London for $10.08 per bushel

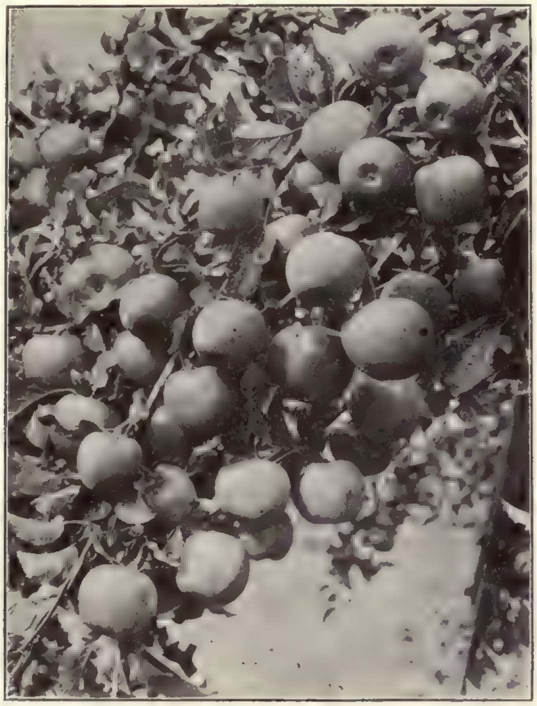
Picking Spitzenbergs. Apples Are Often Packed as They Are Picked in the Orchard.

box. This is a price of about twenty cents per pound wholesale.

While Comice pears head the list as far as prices are concerned, other varieties do not come far behind. Bartlett pears billed from Rogue River Valley in 1907 realized $5.05 per bushel box at Montreal, Canada. A single acre of these pears brought $2,250. From another orchard seven acres of Bartletts were sold for $2,220 per acre. The average yield is seven boxes to the tree and 102 trees to the acre. The first carload of Bartlett pears that was sold this season from the Umpqua Valley brought a price of $2.90 a box. Dr. Bradburn of Roseburg received a check for $1,740 on August 13, 1910, for 600 boxes of his pears delivered at the depot. In growing fruit in southern Oregon, no irrigation is needed, just sunshine and sense.

An orchard owned by Captain Gordon Vorhees of Portland has netted an average of $600 a year per acre for nine years. As an income paying proposition, this orchard is returning ten per cent on a valuation of $6,000 per acre. Mr. M. L. Pellett sold 3,000 boxes of pears from eight acres. On the cars at the shipping station they netted him $4,500. This was aside from the sale of culls. In 1906 Mr. J. H. Gore from seven acres of Bartlett pears received $4,056.17, f. o. b. shipping station. Mr. William Shevele has two Anjou pear trees which annually net him from $60 to $100. Twenty Winter Nelis pear trees netted $660, or an average of $33 each. Anjou pears from a single tree sold in 1907 for $204.75 net. This tree has

been in full bearing for over thirty years and has never failed to produce a crop. In 1907 a part of the Snowy Butte Orchard, containing sixteen and a half acres of 1,200 Winter Nelis pear trees, grown by F. H. Hopkins, produced $19,000 net, f. o. b. Medford. The crop on these same trees in 1909 sold for $17,000 net. Mr. Dillon Hill, who has a fifty acre pear orchard, says: "I could sell Bartletts at fifty cents a box and still make money." But Bartletts do not sell for fifty cents a box; they average from $2.00 to $2.75 per box.



Yellow Newtown Pippins, the Best Selling Apple Raised in Oregon.

For many years New York orchards have been famous for their apples. So have the orchards of Missouri, West Virginia, Colorado and other states. The eastern apple grower learned his business from the accumulated experience of a hundred years or more. Yet during the last few years these eastern growers have crossed the continent to inspect young orchards that were half hidden among the fir-clad Oregon hills, to find out why a New York buyer preferred to pay a bigger price for a bushel of Oregon apples than for a barrel raised by his neighbor at home. The average price New York fruit men have been paying for our Hood River apples during the past three years has been $2.50 per box, with $3.65 as the top price. As a standard size apple box holds about a bushel, this is at the rate of $7.50 to $10.95 per barrel.

The Oregon grower has this advantage. His apples are sold, as a rule, several months before they are picked. There are no long waits or tidings of fruit that arrived in bad condition. The New York dealer, not the grower, takes chances of sale. The grower jingles the money in his pocket as soon as the fruit is delivered at the depot.

On July 23, 1910, George Rae of the firm of Rae & Hatfield, wholesale fruit men of New York, opened the buying season by taking the entire crop of Sears & Porter and August Paasch of Hood River. The combined output will be about 30,000 boxes. On September 1st of this year, Mr. Joseph Steinhardt of Steinhardt & Kelly of New York, concluded one of the biggest purchases of fancy apples on record. He cleaned up the entire fancy pack of the Hood River Fruit Growers' Union, which will amount to between 250,000 and 300,000 boxes or over 400 carloads. This includes many thousand boxes of Spitzenbergs and Newtons, beside Jonathans, Ortleys, Arkansas Blacks, Winter Bananas and other varieties. Where apples are contracted so far in advance the prices are not given out. When I asked one of the growers about profits this year, he said they were entirely satisfactory and showed his teeth just as he did the year he realized $3.65 per box. The Davidson Fruit Company has also concluded the purchase of the entire crop of the Mosier Hills Orchards, which amounts to 12,000 boxes.

Sears & Porter have the largest full bearing orchard at Hood River. The records taken from their books show the average net earnings extending over a period of eight years are above $800 per acre. The actual earnings from a three and a half acre tract of Newton Pippin apples in this orchard consisting of 346 trees planted in 1896, are $24,000. This is not including the present year crop. It can be seen this is better than an average of $857.14 an acre from the fifth year or when the trees began bearing, or it is an average of almost $528 an acre since the trees were planted.

As a rule, a man can make bigger profits on a small orchard from three to ten acres, because he can give it more careful attention. Mr. E. H. Shepard of Hood River received gross returns of $2,240.35 from 160 trees of apples on one and a third acres. After paying all expenses his net profits were $1,400 or more than $900 per acre. Ludwig Struck picked 1929 boxes of first-grade and 400 boxes of second-grade apples from his orchard of less than three acres. He received a total of $4,258. B. R. Tucker, who owns an apple orchard of three acres, according to records shows that in 1906 he received for his apples $2,184.19. In 1907 he received $4,320.30. In 1908 he received $2,367.29. Similar records from the orchard of James Lacey, who owns three acres, show that in 1906 he received $1,764.20 for his crop; in 1907, $3,801.36; in 1908, $2,493.41; in 1909, $2,367.71. This was for first-class fruit. In addition to these returns, Mr. Lacey received several hundred dollars for second-grade fruit.

The profits on apples in other parts of the state hold a very high average. The Williamette, Umpqua and Rogue River, as well as smaller valleys tributary to the coast region, the Powder and Grand Ronde Valleys in the northeastern part, the Mosier Hills and other sections along the Columbia River, all contain very profitable apple orchards.

The best marketable varieties of apples grown in Oregon are the Yellow Newton Pippins and the Spitzenbergs. Jonathans, Arkansas Blacks, Baldwins, Ben Davis, Northern Spies, Ortleys, Winter Bananas, Russets and others are also raised. The varieties of pears that thrive best are Bartletts, Doyenne du Comice, Winter Nelis, Beurre Bosc, Beurre de Anjou and Howell.

Packing Apples Ready For Shipment at Hood River, Oregon.

The largest orchard in the Northwest is that of the Western Oregon Orchard Company in the Rogue River Valley. The tract contains 1,700 acres of which 1,120 have been planted mostly to apples and pears. The company is handling the orchard by the most up-to-date methods. The plan of this company is a stock proposition, a share of stock representing one-half acre. The amount of fruit that this orchard will produce when in full bear-

ing is enormous. As a rule, trees average 500 boxes of fruit to the acre. At a profit of $1.00 a box, it would mean an annual income of $560,000. The Potter Palmer estate owns 100 acres adjoining the Bear Creek Orchard, Rogue River Valley. Eighty acres are in five-year-old apple and pear trees, all perfect in health and growth. Another 1,240 acres owned by the same estate is being developed and planted to fruit trees. One of the most complete and valuable fruit ranches of today is the Eden Valley Orchard formerly owned by the Burrell Investment Company of Portland, but recently sold for $500,000. It is a splendid tract of 605 acres, 500 of which are in apples

Some of the Mosier Hills Orchards Along the Columbia River. Hill Land Along the Columbia River Is Well Adapted for Fruit Growing.

and pears. The apple trees that are in bearing have netted the owners $700 per acre for the past five years. Fifty acres of pears have netted an average of $600 a year for the past nine years.

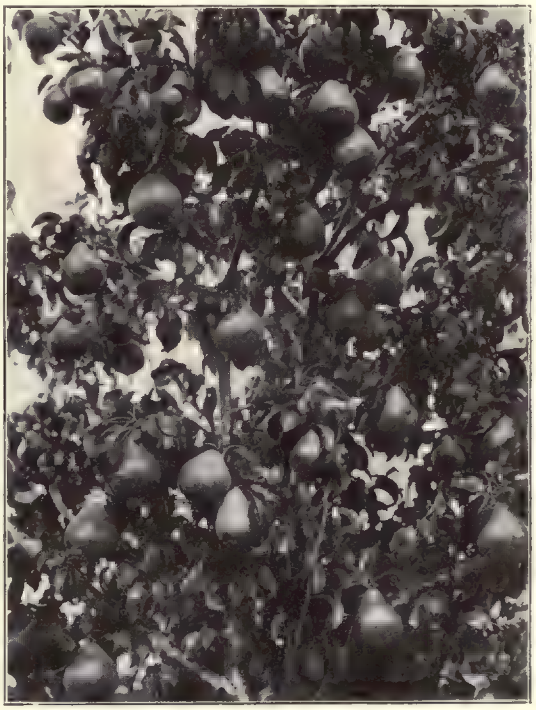
There are, of course, exceptional profits in every business. One may pick out cases where a man in almost any locality makes big profits in chickens, cows, pigs, apples, pears or strawberries. It is an easy matter to find cases where lawyers and doctors make exceptional fees, but these cannot be given as reasons why any average man can get rich by studying law or medicine. Because Mr. M. J. Rimel of Asotin, Washington, during the past summer netted $1,000 from a three-fourths acre patch of strawberries, it is no sign that you or I can do it. Behind all exceptional profits in any line, there is either a struggle story or a person of exceptional ability. The personal equation counts much in success, whether arguing before a jury or raising apples and strawberries.

My aim in the study of fruit culture in Oregon has been to investigate the cases of men of average means and ability, rather than the exceptional cases. Mr. A. I. Mason is one of our best known apples growers. In his orchard he has two varieties, Newtons and Spitzenbergs. This year his trees are thirteen years old. The records show that in 1908 Mr. Mason received $1,200 an acre for his fruit, which is a large return. If I were to give these figures without those of preceding and succeeding years, it might give an erroneous impression. In 1906 Mr. Mason received for his Spitzenbergs $835 an acre and from his Newtons $700 an acre. As a rule, it is the reverse; the Newtons bring the higher price. In 1907 the average returns from his orchard were but $250 an acre. In 1908 they were $1,200 an acre. The crop was so heavy that year that in 1909 he received but $50 an acre. This year he expects a gross income of $1,200 per acre, or even more.

As Mr. Mason said in an address before the Apple Growers' Association: "These figures are exact and not colored in any particular. It will be seen that my orchard should bring me in gross receipts of $700 an acre as an average for five years. All expenses of maintenance will amount to about $200 an acre, leaving a net profit of $500 an acre. From the time the trees were planted until they were eight years old, I have not included the income which was utilized in paying the expenses of development. This, of course, is paying ten per cent on a valuation of $5,000 an acre. It looks big, but is nothing more than any young man who gets hold of a good piece of Oregon apple land can do, if he will only select the right land, plant the best varieties and give them proper attention."

The season of 1909 may be taken as an average year in the Rogue River Valley. I could give examples of where profits of over $1,000 an acre were realized from apples and pears. From $500 to $700 an acre were not unusual profits in berries. With hardly an exception there was a profit of over $200 an acre on all fruit. Where fruit failed to bring that much, it was shown that it lacked intelligent care and work. Here, as in any other case, a person has to work for the money he receives. This is not a land of snap fortunes for lazy people. You cannot plow money out of the ground or pick it off the trees, even though real estate agents may show you pictures of people doing it. But take even the lowest profits, $200 an acre, on ten acres would mean a net income of $2,000 a year. This, with all the fruit and vegetables a family needs, with a cow and a few chickens, is from a purely money standpoint better than a salary of $200 a month in a city position. The point is, an exceptional man in a city position cannot raise his salary from $2,000 to $5,000 by straining his energy to the breaking point, but he can do it in the country. The country opens his way to a broader future.

Fruit growing is a profession that any man or woman of average intelligence can learn. The main pre-requisites are energy and work. A person does not have to start in young to learn how to grow apples or pears. School teachers, doctors, lawyers or preachers all make good fruit growers. Many of the most exceptional cases of profits in fruit are secured by those who have failed in health or



Comice Pears From a Rogue River Valley Orchard, a Fruit That Has Sold as High as Twenty Cents a Pound Wholesale in London. One of the Most Expensive Fresh Fruits Grown.

worn out in the city grind. A certain man from New York, according to his family physician, had one year to live. He settled on the western slope of the Cascades and was soon absorbed in the companionship of his trees. He ate ravenously, slept well and forgetting to die, has now overrun his time eight years.

The lure of the orchard is being answered by hundreds of thousands of people who are in business in the city, who are sprouting fortunes by putting their spare earnings in the development of an orchard instead of depositing them in a bank. Professor J. L. Dumas, superintendent of schools at Dayton, Washington, began planting his sav-

ings in an orchard thirteen years ago. He was not a trained horticulturist, but during his spare time he supervised the work on his orchard. Today this 100-acre orchard is netting nearly $50,000 a year. An implement dealer in the Rogue River Valley bought a cheap tract of bottom land six years ago. He planted twenty-seven acres of apples. Over a year ago he had an offer of $14,000 for the orchard. A Portland letter carrier bought a tract of land at Hood River in 1897. The trees were planted the following year. In 1907 the net returns from his orchard were slightly under $18,000.

The methods applied in an Oregon apple orchard may not be picturesque, but they are scientific. Trees are not rambling, nor does each have an individuality of its own. They are stripped of character till all are of one monotonous size and shape. The crowns start in a few feet from the ground, bush-like, so every portion can be conveniently reached. Instead of a pleasant carpet of green grass, one cannot even find a weed. The floor of the orchard is a layer of fine dust which prevents the surface from baking and makes the soil retain its moisture. Trees are carefully sprayed during the year. As an illustration of the care our apple growers take of their orchards, one orchard turned off 200 boxes of strictly first-class fruit, and but sixty wormy apples were found in the entire season.

Picking time is a busy season. Ladders are not placed in the trees, but alongside of them. The fruit is taken with the full hand in order to distribute the pressure evenly over the whole surface. It is turned gently with a rapid twist to one side in order to detach the stem from the twig, the stem must go with the apple. Each apple is laid carefully in a bucket or basket, not dropped in. The apples are not dumped in bins or shipped in barrels. They are sorted carefully and wrapped in tissue paper with the ends twisted tightly about the stem so there will be no injury to other apples. Then they are placed in rows and tiers. The grade must be uniform, the same number of a certain size going into each box. The largest grade of apples runs fifty-four to a bushel box, while the smallest runs one hundred and twenty-eight to a box. It is all, of course, painstaking work. But in the end, each box with its lace paper trimming looks as fine as a box of French candy.

By standardizing their apple or pear crops, our Oregon growers have built up the reputation and price. At Hood River, for instance, the entire output of the valley is handled by professional packers. Not a grower packs his own fruit. A merchant who receives Hood River fruit, never has to look at the bottom layer. He glances at the stamp on the outside of the box. Everything is exact, without a single guess. You could bite into ten thousand apples and not find a single old-fashioned one, red outside and rotten at the core. "You can have the whole carload if you find a bad apple," says the packer. It is all according to good system, and a new grower with one box of apples to sell gets the same price and works on even terms with a man who has 30,000 boxes and has been perfecting his methods for years.

With a great number of new orchards set out during the last few years, the question of over-production has often been raised. Shall we produce too many apples in a few years and glut the market, causing a fall in prices? Figures show that it will be many years before a possibility of such a thing could exist. The apple crop in the United States in 1896 was 69,070,000 barrels, while in 1908 it was 23,000,000 barrels. This is a marked decrease in production. Oregon is at present furnishing a little over one per cent of the country's apple supply—hardly a drop in the bucket. Our growers are content to supply the fancy trade, letting other states furnish the bulk. In an overloaded market, fruit of poor quality suffers. There can never be an over-production of A-No. 1 doctors and lawyers, so of apples.

The whole state of Oregon is divided into a number of different valleys that are well adapted for the intensified culture of fruit. The Rogue River, one of our large fruit growing sections, is at the southern end of the state and has an area about half as large as the state of Massachusetts. It is a big dip at the southern extremity of the Cascades where they join the Siskiyous. The whole valley with its surrounding slopes is unusually adapted for fruit culture. Hood River, our smallest apple valley, is about sixty-five miles east of Portland. It stretches back from the Columbia river toward Mt. Hood for a distance of twenty miles. It has an area of about 50,000 acres that will eventually be a continuous orchard. There are now about 10,000 acres of orchard in Hood River, but only 1,000 acres are in bearing.

Many people of limited means have bought orchard land in these valleys and have paid for the development of the orchard by raising berries. The advantage, for instance, of strawberry raising lies in the fact that these can be raised between the rows of trees and they come into bearing a year after being planted. While the apple grower is waiting five years to get returns from his trees in this way he gets an immediate income of $150 to $250 per acre.

The expense of producing strawberries is small, as the cultivation and other expense costs less than $20 an acre. The cost of picking and crating is about sixty cents per crate. The demand for Hood River berries has always been good and the price has never fallen below $1.75 per crate. For the greater part of the season it is from $2.50 to $4.00 a crate. The Clark's Seedling is the best in flavor and keeping qualities, and is practically the only variety raised. During the World's Fair at Chicago, a shipment of these berries after four days on the road was entered in competition with other berries picked within a few hours' run of Chicago. The Oregon berries carried off first prize.

The supply of berries remains about the same at Hood River: 60,000 crates were shipped last season. As orchards grow in size, berries are crowded out, but new patches are being planted where new orchards are being started. One may find plenty of berry growers who are satisfied with the returns they get and are not drawn into apple raising; for berry culture, although not so profitable in the end, is less exacting in its demands on the land owner, and this is a recognized advantage to many people.

The picking and packing of fruit give many home builders employment for themselves and families for several months of the year. Many families who are just starting orchards on limited capital, depend on working in the fruit harvest to pay expenses during the winter. Girls and women are good at packing fruit and easily earn from $1.50 to $3.00 a day. In exceptional cases, a woman packer makes as high as $5.00 packing apples or pears at five cents a box.

As to the price of apple land, property that is cleared and ready for trees within a few miles of town, can be bought from $150 to $300 per acre. Unimproved property can be bought from $50 to $150 per acre. Such land can be cleared at from $50 to $75 per acre. Suppose one pays $200 an acre. The cost of apple trees, sixty-five to the acre at twenty-five cents each, would mean $16.25. The cost of planting, plowing, cultivating, spraying and pruning for the proper care of an orchard from the time of planting up to the fifth year, would approximate $10 per acre. For a ten-acre orchard, therefore, the total expense during the first year would be $2,262.50. Each year after that, the expense would be $100, making the total expense for the first four years amount to a little over $2,500. By the fifth year, the trees should pay expenses and a small return on the investment. From that time on, the income should increase rapidly.

A COLLEGE AND ACADEMY FOR YOUNG WOMEN AND GIRLS.

The attention of our readers is respectfully called to the advertisement which appears in this issue, of St. Mary-of-the-Woods College and Academy for young women and girls. This institution, which was founded over seventy years ago by the Sisters of Providence, among the hills and woods of southern Indiana, has been developed into one of the most beautiful places of its kind in the country.

Its reputation as an educational institution for young women and girls is world wide, and numbers among its graduates some of the brightest women of this country.

To those of our readers desiring a school to educate their daughters in a way that tends to the development of noble womanhood, we most earnestly recommend this school as the one that would meet their fondest hopes. Representatives of the same families for three generations past are in attendance at this school, which is sufficient evidence to convince the most exacting parent of the excellency of this institution.

Evil Spirit Turned Healing Springs Into Death Trap for Indians

By J. F. CRAWFORD.

THERE is something intensely interesting about the early history of any country. People listen to the tales of early day hardships and privations of early settlers, their struggles against the wilderness of the land, as well as against the Indians, who have always disputed the advance of civilization.

No place in the United States has a more thrilling early history than the southern part of Carbon county, Wyoming, known as the Saratoga valley. The North Platte river rises in North Park, Colo., and after leaving the park, enters Wyoming and flows north for about 175 miles, when it makes a great bend and flows south into Nebraska.

The Saratoga valley is situated on both sides of this river where it enters Wyoming and is flanked on the west by the Sierra Madre range and on the east and northeast by the Medicine Bow range. The town of Saratoga is situated midway in this valley, on the North Platte river, where hot springs, some fifteen or twenty in number, gush from the ground. These waters contain medicinal properties of great value and are much frequented by rheumatic patients and those afflicted with kidney or stomach troubles.

The earliest settlers tell stories of how, every summer, the Indians flocked here from every quarter, to bathe and drink of the waters. For how many years the Indians had been doing this no one can tell, but it is certain that such had been their custom for many centuries.

So great was the value the Red Men placed on the medicinal qualities of the waters of these springs, and so great was the demand for their use, that a compact was formed, between all the tribes of this country, that this valley should be neutral ground, and that when once within the confines of the mountain ranges that bounded the valley, peace should reign and no hostilities allowed. Death or extermination was the penalty exacted of every Indian, or tribe of Indians, that should violate this compact.

Home of J. F. Crawford, Saratoga, Wyo., Editor of the Saratoga Sun. Pyramid of Elk Horns Shown in Foreground.

The result was that the teepee trails were thick that led, from every point of the compass, to this spot. Hostile tribes laid aside their weapons and discarded their war paint as soon as they crossed the divides leading to this valley. Utes, Arapahoes, Shoshones and Sioux fraternized, danced, and hunted together in amity, while within the confines of the valley, only to resume their deadly hostilities, once they got beyond the valley's border. They assembled here, each summer, by the thousands and camped all along the North Platte river and its tributaries.

The valley abounded in game, and the pasture along the many small streams, as well as the river, afforded excellent grazing for the herds of Indian ponies. It was a kind of general playground, where the eternal vigilance, that marked the lives of the many western tribes, was laid aside and the warrior could lie down to peaceful slumbers, assured that he might fear no foe.

This state of neutrality and peaceful tranquility, which must have lasted for, no one knows how many thousands of years, was bound to terminate, and its termination in this case was a disastrous one for the Red Men. In the year 1847 the Mormons passed through this country and left smallpox in their camps, which was spread among the Indians. They promptly fled, with this new, strange, disease, to their old-time remedy, the hot spring of this place.

Their manner of treating the disease was almost as deadly as the disease itself. They made wickyups of willow boughs over the springs, placed the patient inside and, when he was reeking with perspiration, he would jump into the ice-cold waters of the North Platte. The result was almost universally fatal. Old trappers and frontiersmen of that time say that not less than twenty thousand Indians died of smallpox, and that their bones were to be found everywhere strewing the valley.

The Indians, when the waters failed to cure them, concluded that a bad spirit had gotten into the waters and this belief spread to all the tribes in this part of Wyoming. In consequence the springs were looked upon as haunted and they left, never to return here to bathe. The old-time compact was broken and this happy hunting ground became as other places, open to hostilities and to all kinds of Indian warfare and depredation.

The Medicine Bow range, which lies to the east and northeast of this valley, terminates abruptly in a huge mountain, "grand, gloomy and peculiar." This mountain, some 12,000 feet in height, is known as "Elk Mountain." For a number of months each year its top, which is above timber line, is covered with a thick mantle of snow. It is covered on the west and north sides with a dense growth of pine timber and small streams have their head in the canons and defiles that seam its every side. It is an awe-inspiring sight, a landmark that can be seen for hundreds of miles from every point of the compass. In its dark canons and rugged defiles many bloody scenes have been enacted and the history of the mountain would fill a book.

Geologists tell us that this entire country was, ages and ages ago, a level tropical land. They affirm that it was the habitat of the immense dynosaurs and all of the immense creeping things of that age, so far, far back in the history of time, that one can only guess at the date. The country was hot; palms flourished and tropical plants and trees abounded.

These same learned men tell us that on the top of Elk Mountain there are about two acres of the land that existed in that day. There it lies elevated by some cataclysm of nature, storm swept, bleached by sun and whipped by wind, a mute testimonial of that age so far away. In this tract of land are to be found the jawbones of camels still perfectly sound. There are many other spots in Wyoming where these jawbones can be found, but nowhere are they so perfect as on that high mountain peak in the original soil of that day.

To prove that this was a tropical clime at one time these same geologists and searchers after the ancient, have unearthed the bones of immense lizards, some of them over 60 feet in length. Other immense fossils, many of them of animals almost, or entirely unknown, to the scientific world, have been found here in Wyoming, and now fill the Museum of the University of Wyoming, at Laramie, the Smithsonian Institution and the Yale and American Museums. Some of the most valuable finds of this character the world has ever known have been made here in Wyoming.

In the mountain passes of Elk Mountain and in its mighty canons have been enacted thrilling scenes, many of which were indeed tragic and fateful. In one of the many canons on the sides of that mountain, a place that ended in a perfect cul-de-sac, are to be found the mute and eloquent evi-

dences of a struggle, between a party of emigrants and a band of Indians, that ended disastrously for the whites.

The early settlers on Pass creek, a small stream which comes out of the Medicine Bow range and flows westward, between Elk Mountain and the "Kid," tell gruesome stories of this same fight, and of the wagon irons and pieces of harness still to be found on the ground where the little band of emigrants fought their last battle. But one grave was to be found there, that apparently of a chief, as the occupant was buried in a sitting position, with all his arms and adornments on him. One of these adornments was a belt made of silver dollars hammered flat and riveted together.

In later years, an old Indian squaw, who was present at the massacre, told of the tragedy. She said the band of emigrants undertook to find a short cut through between the mountains, instead of following the old emigrant trail, and were driven into the canon and hemmed in against a solid wall, where every member of the band was killed. The wagons were burned, the harness cut to pieces and the men, women and children burned at the stake. Only one Indian, a chief, was slain.

J. F. Crawford, Editor Saratoga (Wyo.) Sun, in His Office.

The tale of this squaw is the only word that ever reached the civilized world from that fated band of white people. But the early settlers used to go there for wagon irons, which proved very useful during the early days of frontier life.

Elk Mountain was, in early days, a resort for train robbers and horse thieves, for which purpose it was admirably adapted by the numerous small streams, the dense growth of timber covering its slopes and the fact that there were no nearby settlers to spy out and report the doings that took place there.

Many tragedies, between officers of the law and men who sought shelter in its fastness, have taken place in the mountain defiles. But it is now surrounded by ranchmen and settlers and has become peaceful and quiet these later days.

While the game abounds in its forests, and while it remains the same mysterious sentinel of the ages, it has been invaded by the prospector and the miner, and the sound of steam whistle calls men to labor in the copper mines, that are being sunk in its rugged sides.

SHOW PUBLIC SPIRIT.

The Hearst trophy won by Otero County, Colo., at the Irrigation congress exposition has been formally turned over to the county commissioners. The space allotted the Arkansas Valley in the Chicago land show is about the best that the whole auditorium in Chicago presents. It is one of the largest individual exhibits of the big show. Colorado people are showing great public spirit in the matter.

THE MINERS' INCH.

A letter has been received from the Button Land Company, which is shown below, asking us to explain what is meant by the phrase "the miners' inch." As shown in our reply, with illustrations, this matter was covered pretty thoroughly. We are always glad to answer inquiries of this kind which may be sent in to us.

THE INQUIRY.

Lincoln, Neb., Sept. 22, 1910.

Irrigation Age,
Chicago, Ill.

Gentlemen:

Kindly advise us, by return mail, how much land you consider one miners' inch of water will successfully irrigate, and explain what is meant by this phrase?

Thanking you in advance, we remain,

Yours truly,
BUTTON LAND COMPANY.
By A. L. Button, Pres.

OUR REPLY.

Button Land Company,
Lincoln, Neb.

Gentlemen:

Your letter of September 22 reached this office shortly after I had started on a trip to the coast, and it did not reach my hands until my return a few days ago. The fact that all inquiries of this character are answered by me will explain the unusual delay. I regret that it did not reach me before I left, when an immediate reply would have been forwarded.

It is my intention to publish your inquiry and the enclosed reply in our November number, and with that in view I have prepared rough pen drawings from which cuts will be made to accompany same—hence the reference to Figure 1, 2 etc.

The term "miners' inch" does not mean the same thing everywhere as the quantity of water passing through the aperture is dependent on the head, which is subject to considerable variation, fluctuating from 5 to 7 inches—the most common head being 6 inches above the center line of a 2-inch discharge opening; thus in Fig. 1, which is a section through a measuring box, let AB be the height of the slit, which we will assume to be 2 inches; the distance AC should be made not less than 2 inches to obtain full contraction. In Fig. 2 is shown the front

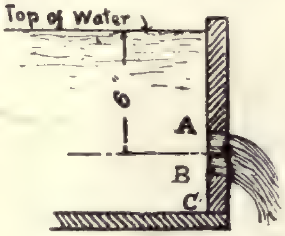


Fig. I.

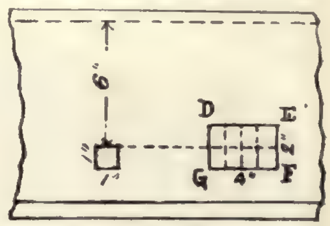


Fig. II.

elevation of the box and D E F G indicates the opening which is shown in this case to be 2"x4", making 8 square inches, and the volume of water flowing through would represent 8 miners' inches. The original standard quantity of a miners' inch is the

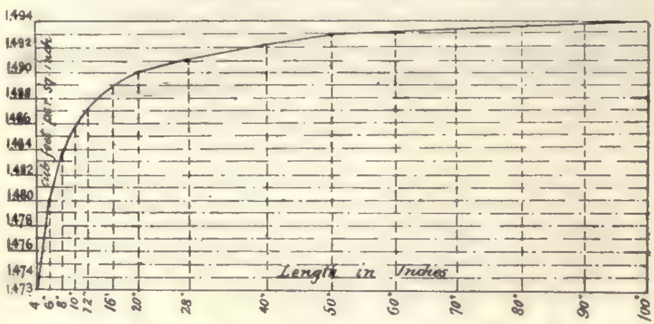


Diagram Showing Discharge Per Square Inch of Opening from 2"x 4" to 2"x100" Under a Six Inch Head. The Vertical Divisions Are Cubic Feet Per Minute, Ranging from 1.473 to 1.494 as the Width of Slit Increases from 4" to 100".

flow through an opening 1 inch square under a 6½ inch head, shown in Fig. 2, under which condition the discharge is equal to 11.625 gallons of water per minute; hence, 8 miners' inches should represent $8 \times 11.625 = 93$ gallons per minute. As a matter of fact the 2"x4" opening discharges considerable more than 8 times the amount of water of the 1"x1" opening, for the reason that the hydraulic radius of the larger hole is greater

than that of the 1" square hole, hence the California water companies in reducing the head to 5" were probably actuated by the desire to keep the flow down to the required 11⅝ gallons per minute per square inch.

To investigate the conditions of the flow through the standard one-inch square opening let us consider the following data: there are given the head as 6.5"=.54 ft.; also the cross section = 1/144 sq. ft. = .0069, and the quantity = 1.554 cu. ft. per minute = .0259 cu. ft.; divide .0069 into .0259 gives 3.74 ft. as the velocity per second.

The theoretical velocity would be $V=\sqrt{gh.}$, or since $2\sqrt{2gh.} = 8$, it would be $8\sqrt{.54}=8x.73=5.84$ ft.; the loss between the theoretical and observed velocity represents the loss due to friction, thus dividing 5.84 into 3.74, which is .64, gives the constant multiplier or coefficient for the theoretical velocity with the opening one inch square. It is equivalent to a reduction in head, for if we square 3.74 and divide it by 2x32.16, we get the effective head: .218 ft. = 2.616.

This loss decreases as the opening increases, which may be seen from the annexed diagram which shows the discharge per square inch for different sized openings, varying from 2"x4" to 2"x100"; it also indicates clearly that the gain is most rapid up to 12" or 16" widths, though there is a gain up to 100 inches.

From the foregoing it is seen that the miners' inch is not a very distinct unit to work from unless the quantity of water, 11.625 gallons per minute is taken as the unit.

To revert back to the inquiry "how many acres can be irrigated by the water supply of a miners' inch?

It depends on how much water he will require per acre per day. The miners' inch stream will furnish him in 24 hours 24x60x11.625=16,740 gallons; divide this by 7.48 gives him 2,238 cu. ft. An acre has 43,560 sq. ft. of area; multiply 2,238 by 12 gives 26,856 sq ft. one inch deep of water; divide this by 43,560 and you will have the depth of the water over one acre; this is about .62 inch or nearly ⅝ inch. It is safe to say though that all this water will not reach the land, as there will be a loss due to evaporation, seepage, leaks, and other causes.

Trusting that this information will be of service to you, we are,

Yours very truly,

THE IRRIGATION AGE,

D. H. ANDERSON, Editor.

Great Dam Completed.

One of the greatest engineering feats and earth construction works upon the continent has just been completed at Necaxa, Mexico. It is the building of the largest hydraulic fill dam in the world by the Mexican Light & Power Company of the City of Mexico. It is larger than the famous Gatun dam of the Panama canal, both structures being of the same type.

Supreme Court Decisions

Irrigation Cases

INDIAN RESERVATION.

No right of appropriation of the waters of a stream for irrigation purposes can be acquired by one illegally occupying land on an Indian reservation, prior to the opening of the reservation to settlement under the homestead law. *Avery* v. *Johnson*. Supreme Court of Washington. 109 Pacific 1028.

POLLUTION OF WATER.

An appropriator making no use of water below another appropriator's dam is not entitled to an injunction restraining the other from polluting the water by allowing sheep to go into it. *Sullivan* v. *Jones*. Supreme Court of Arizona. 108 Pacific 476.

COMMON USE OF WATER.

Consumers of water under contract with an irrigation company cannot complain of any use of the canal granted by its owner, or acquired by operation of law, not interfering with their rights. *Hackett* v. *Larimer & Weld Reservoir Co.* Supreme Court of Colorado. 109 Pacific 965.

IRRIGATING INCREASING AREA.

A diversion of water to irrigate an increased area of land cannot relate to an appropriation made several years before, where there was little diligence in cultivating the land under such appropriation. *Ison* v. *Sturgill*. Supreme Court of Oregon. 109 Pacific 579.

CHANGE OF PLACE OF STORAGE.

Change of place of storage or use of water appropriated for irrigation from one reservoir to another, so far as the rights of appropriators are concerned, is analogous to a change of place of use from one tract of land to another. *Windsor Reservoir & Canal Co.* v. *Lake Supply Ditch Co.* Supreme Court of Colorado. 98 Pacific 729.

(Continued on page 662.)

THE LOWER RIO GRANDE VALLEY

BY

R. C. Brophy, M. D., D. D. S. Chicago.

THE Delta of the Rio Grande river, in Texas, known as the Lower Rio Grande valley. occupies a geographical position farthest south of any agricultural land in the United States. It lies more than four hundred miles south of the southern boundary of California, a line drawn through it, and across the continent from east to west cutting through the peninsula of lower California well toward its southern extremity, and just clipping off the tip of the peninsula of Florida. It is in about the center of the southern boundary of the United States, and therefore is more accessible to the markets of the country generally than any other semi-tropical region, or region of its character, in the United States, enjoying in this particular a decided advantage over California and Florida, its principal competitive regions. The valley extends about one hundred miles up the Rio Grande river from the Gulf of Mexico, and varies in width from, approximately, fifty miles at its eastern extremity, or the gulf line, to a pointed termination at its western extremity, and it comprises approximately 500,000 acres, which must be considered a limited area when it is known that the state in which it is located has 170,099,200 acres within its limits.

TOPOGRAPHY.

While the eastern or lower portion of the valley is devoid of pronounced undulation, the larger part of the inland boundary is marked by a series of well defined shelves, or "lifts," and though the quality of the soil be not considered at all, these natural terraces lying in well developed lines and levels could scarcely fail to convince one that at some time in the past this valley was the bed of a body of water. Further proof that these shelves were at various ages shore lines is found in the fact that the alluvial character of the soil ceases above the upper lift. Study of the Lower Rio Grande valley is an interesting one to topographers.

Naturally one would know that since the valley lies alongside of a rapidly flowing river there must be a corresponding fall or depression in the topography of the land, and in this case the decrease in altitude from west to east is abundant to facilitate irrigation and insure perfect drainage, so necessary in the cultivation of land through irrigation or otherwise.

SOIL.

As has been intimated, the soil of the Lower Rio Grande valley is alluvium, and its richness is plainly apparent to the most casual investigator. There is no rock in the valley, no gravel, and except to a limited extent no sand. All rivers accumulate and carry along with them vegetable matter in a greater or lesser state of decomposition and solution, and this matter when deposited in solid form, done through evaporation of the water, or its absorption into the ground, is known as silt. It can be imagined that the Rio Grande river, after its meandering flow of 1,800 miles, becomes heavily loaded with this silt, and it is this matter, heavily charged with snail shells, that makes up the soil of the valley. The depth of the soil is rarely sounded. In the digging of wells silt composition has been found at depths ranging down to seventy-five feet. That the richness and fertility of the soil of the Lower Rio Grande valley is sufficient to preclude the necessity of artificial fertilization for very many years to come is not only a foregone conclusion from a scientific standpoint, but it is, also, a practically demonstrated fact shown through the historical experience of the promoters of the older plantations of the valley, some of which have grown sugar cane—a crop which yields from thirty-five to sixty tons to the acre—consecutively for thirty years without a thought of spreading fertilizer upon the land, other than that carried to it through the water with which it is irrigated.

In its natural state the land of the valley is thickly covered by mesquite, ebony and some other varieties of trees, and prickly pear. Clearing is done at a cost of from six to ten dollars per acre, and when the land is cleared it is very easily placed under a perfect state of cultivation, owing to the fact that it is generally unsodded and is left by the stirring plow in a friable condition.

CLIMATE.

The far southerly location of the Lower Rio Grande valley would quite naturally lead to the belief that while the winters would be mild the summers would be extremely warm and oppressive, but while the former is true, the latter is erroneous. As a matter of fact the climatic conditions in the valley present a degree of uniformity, for the year, which is surprising, and in the writer's opinion is not to be found in any other section of the United States.

The winters, or rather the winter months, show no particular change in vegetation, or verdure in the valley; trees hold their leaves unchanged, flowers keep right on blooming, land is planted and crops harvested without interruption. In the summer months, while in the open in the forenoon of the day, the sun is "hot," one can step into the shade and be cool. The heat is never oppressive, sunstroke or heat prostrations are unknown.

IRRIGATION.

The Lower Rio Grande valley is semi-arid territory. It enjoys a natural rainfall of twenty to thirty inches annually, but this quantity of rain is insufficient, owing to the absorbing quality of the soil, for vegetation, and hence irrigation is depended upon in agriculture.

For the amount of territory in the valley, there probably is not a section of the United States that has so extensive irrigation development and facilities. Ramifying up through the valley from the river, there are at present over forty great irrigation canals, equipped with the most modern pumping machinery and in active service. The amount of money invested in irrigation development is immense, and of itself furnishes assurance that a great amount of confidence is reposed in its future.

LABOR.

The question of labor has become a decidedly important one in agriculture, and in this particular the farmer of the Lower Rio Grande valley enjoys a great advantage. Closeness of proximity to Mexico, and the fact that the valley has a large Mexican population, makes this class of labor plentiful. Able-bodied men may be hired for 65 to 75 cents per day, and they board themselves. One must wonder how a man of family gets along upon this income, but they seem to do it.

PRODUCTS.

The Lower Rio Grande valley possesses qualifications in the production of fruits and nuts equal to those of California or Florida. All varieties of citrus fruits, figs, grapes, dates, pineapples, papallas, bananas, guavas, and pecans, English walnuts and almonds are grown with success.

The valley is a wonderful Indian corn region, two crops being produced each year from the same land, each of which yield enormously. White corn is the staple food of the Mexican laborer.

Cotton grows to perfection in the valley, as does alfalfa. The latter crop is cut from six to ten times a year, and averages more than a ton to the acre per cutting. Broom corn is grown with success and is a profitable crop.

Cabbage, cauliflower, Bermuda onions, cantaloupe, watermelon and every variety of vegetables are indigenous to this valley and are extensively produced. Loaded in heated cars, they are shipped to northern points in the dead of winter, and reach the markets when prices are highest, netting the producers enormous profits. Sugar cane is the leading crop produced in the valley and it is the capacity of the soil to produce this crop more prolifically and of better quality than is done elsewhere, either in our own country or abroad, that adds most to the fame of the valley. It surprises northern farmers to find that sugar cane comes up from the stubble after cutting, one planting only being required for a period of from five to eight years. There are now thousands of acres of sugar cane in cultivation in the valley and some of the finest sugar mills in the country are in operation in season, or in process of construction.

SPORTS AND RECREATION.

It might be well for me to call attention to the opportunities offered in the Lower Rio Grande valley to those who have sporting proclivities, or are bent upon recreation. In the first place those who so desire may take baths in the surf, with but few exceptions, every day in the year. Off the coast, in the Gulf of Mexico, and in the rivers and aroyos connected with it, the gamiest of fish are plentiful, while both feathered and animal game, including geese, duck, quail, pigeons and wild turkey, and deer, bear, wild hogs, coyotes and jack rabbits also are plentiful in their haunts. As for automobiling, it would be difficult to find a region where the roads are more perfectly adapted to this sport. The old military road, established by the government away back about the time that Santa Ana met his "Waterloo" at San Jacinto, and the Lone Star state took its big place amongst the states of the Union, extends from Brownsville to El Paso, a distance of something like eight hundred miles, and passes alongside the Rio Grande through the valley. This road is a veritable boulevard and is ideal for auto touring.

UNCAPPED WELLS. (Continued from page 659.)

Where defendants had been in the use of wells alleged to constitute a diversion of the waters of a stream, to a part of which complainant was entitled, for more than five years, complainant's suit to restrain the maintenance of the wells was barred by laches. *Hudson* v. *Dailey*. Supreme Court of California. 105 Pacific 748.

TRANSFER OF RIGHTS.

A party claiming the right as a prior appropriator of the water of a stream by virtue of a right initiated by notice given by a third person as required by Civ. Code, § 1415, is entitled to show the agreements whereby the third person's rights are vested in him. *Wishon* v. *Globe Light & Power Co.* Supreme Court of California. 110 Pacific 290.
129 Southwestern 840.

CHANGE OF METHOD.

Parties owning the right to the use of water may change the method of conveying it to the point of use, if such change does not materially prejudice others' rights; and in doing so any dry ravine, gulch, or hollow, as well as the natural channel of a stream, may be used by the appropriator of water in its transmission to the place of use. *Hough* v. *Porter*. Supreme Court of Oregon. 98 Pacific 1083.

UNDERGROUND WATER BEARING STRATUM.

Where the accustomed flow of a stream is more than necessary to supply an underground water-bearing stratum supplying complainant's land with water for irrigation, the burden is on an appropriator, claiming the right to appropriate the surplus flood waters of the stream for use beyond the watershed, to show that such flood waters were in fact wasted or lost waters. *Miller* v. *Bay City Waters Co.* Supreme Court of California. 107 Pacific 115.

CHANGE OF PLACE OF USE.

Where the owner of an irrigation water right in the use of water from a common dam and ditch was entitled to water to irrigate 60 acres of a certain tract, he was entitled to use such right to irrigate a similar quantity of other land pursuant to such right, involving a mere change of the place of use, and no injury to any other person interested in the water. *Walnut Irr. Dist.* v. *Burke*. Supreme Court of California. 110 Pacific 518.

RIPARIAN RIGHTS.

Where water flows from a river into a slough, or from the slough into the river, as the water in one may be higher than in the other at a particular season, a person owning land abutting on the slough has the equal right to take a reasonable share of water therefrom for irrigation with another person who owns land abutting on the river. *Turner* v. *James Canal Co. Supreme Court of California.* 99 Pacific 520.

MAINTENANCE OF DITCH.

Where several persons are tenants in common in an irrigation ditch and dam at its source, each is responsible in proportion to his interest for the maintenance and repair of the dam and ditch, and in case of default of one or more, the others may make the repairs for which the defaulting party is liable for his pro rata, but such a failure by one does not justify another in making up the loss occasioned by drawing off the water from the former. *Carnes* v. *Dalton*. Supreme Court of Oregon. 110 Pacific 170.

CONCLUSIVENESS OF JUDGMENT.

If decrees adjudicating water rights, rendered in 1889 were absolute and unconditional, they cannot be reopened by a suit brought in 1894 to restrain some of the parties thereto from using more than a certain amount of water, or for other material change, in absence of fraud in procuring them, though, if such decrees were conditional, such a suit was the proper procedure for protecting the rights of the parties, and ascertaining completed appropriations. *Drach* v. *Isola*. Supreme Court of Colorado. 109 Pacific 748.

PRIORITIES.

A complaint to determine the priority of irrigation water rights is insufficient where it does not definitely describe plaintiffs' lands, and does not show that any particular land needed irrigation, does not specify the amount of water diverted nor the amount needed to the acre, or for any specific land, and does not show how much water plaintiffs' grantors acquired a right to use; an allegation that plaintiffs were entitled to all the water in a creek during the dry season being too indefinite. *Porter* v. *Pettengill*. Supreme Court of Oregon. 110 Pacific 393.

(Continued on page 675.)

IRRIGATING MACHINERY.

The Chicago Land Show will attract more people directly interested in practical irrigation, than any other event has attracted for a long time. Those who have land to sell, as well as those about to invest, are much interested in the best methods for cutting canals and ditches.

There will be an attractive exhibit of Ditch Cutting Machinery shown at the Land Show in the Coliseum by The Austin-Western Co., Ltd., of Chicago. This firm sells the famous New Era Ditcher and Wagon Loader, which has played a leading and successful part in the history of irriga-

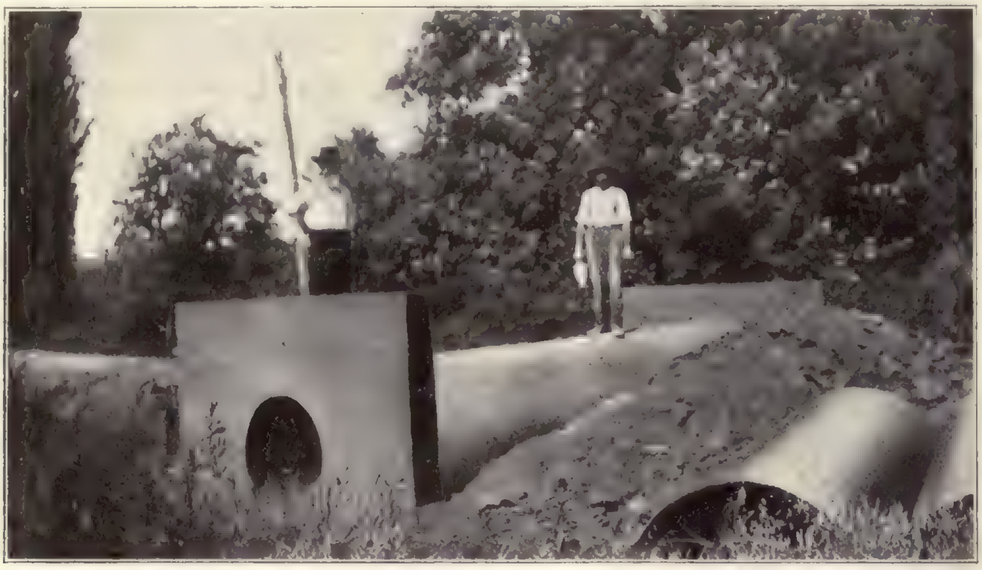
(Continued on page 672.)

Austin-Western Ditching Machine in Operation.

MIRACLE COLLAPSIBLE STEEL FORMS.

We are presenting herewith halftone showing concrete culvert and the two Miracle Collapsible Steel Forms used in making same.

Miracle Collapsible Steel Forms are built in four standard sizes. Diameters, 12 inch, 24 inch, 36 inch, 48 inch. Length, 6 feet to 10 feet. Other sizes built upon order.



One of the main uses for which the collapsible steel forms are designed is for the building of flumes, conduits and continuous pipe lines. These are made in such a way that the ends overlap, furnishing a tight, smooth joint, and permitting as many to be used in a series as the extent of the project requires.

The Marsh Company has issued a 128-page booklet dwelling on the concrete industry. This booklet has over 500 illustrations showing various buildings, faces of blocks, machines in operation, etc. It also describes the company's plan department whereby prospective customers may get modern plans and specifications at a minimum cost.

A copy of this booklet may be secured by addressing Marsh Company, 983 Old Colony building, Chicago.

WONDERFUL WESTERN APPLES.

Exhibit Being Made in the Fort Dearborn Building, 184 Clark Street, by the Arcadia Orchards of Washington State Proves Sensation—Splendid Investment Opportunity Seems to Lie in This Direction—Apple Supply Less; Demand Greater.

Have you seen those western apples? If you have not, go and see them.

The Arcadia Orchards Company, of Spokane, Washington, has established an exhibit of wonderful Spokane Country apples in the Fort Dearborn Building at 184 Clark St.

The Arcadia Orchards are located in the heart of the Inland Empire, which lies between the Rockies and the Cascades, and which reaches from Colorado far north into British Columbia. The orchards are about twenty-two miles from Spokane. They occupy a fertile plateau which, tipping to the south, enables gravity irrigation from the rivers and lakes at the head of the basin. The Valley of Arcadia seems especially adapted for irrigation. Dragon Creek, fed by never failing springs, flows from the north to the south end of the valley.

Two Four-Year-Olds of the Arcadia Valley.

A storage reservoir has been built across this creek which supplies one of the ditches. Water for irrigation purposes is taken from Dragon Creek, Loon and Deer Lakes.

The soil of Arcadia is a rich sandy loam, absolutely free from alkali and gravel. It is in its virgin richness and of great depth, varying from six to twenty feet.

The Valley of Arcadia was in its natural state heavily timbered with pine, fir and tamarack. The Arcadia Orchards Company has spent a vast amount of money, time and labor in clearing, irrigating and preparing the soil for orchards. An irrigation system has been installed at a cost of $100,000.

Arcadia is not only a land of opportunity for making money but it can also be truthfully called the "Land of Sunshine and Health." The climate is ideal; the summer days are long and cloudless and the nights are always cool. On account of the altitude of 2,100 feet the air is pure and invigorating.

Experienced orchardists plant, cultivate and care for the orchard's tracts purchased and bring the trees to bearing, making success certain even to the inexperienced. Skilled irrigation engineers supervise the placing of every tract under irrigation.

Home building in the valley is inexpensive as there is an unlimited amount of timber in this district, making lumber cheap for building purposes. Deer Park, a prosperous city of 1,500 inhabitants, is located in the center of the valley.

The exhibit of apples in the Fort Dearborn Building, 184-A South Clark street, in this city, is in charge of Mr. F. E. Goodall, who will be pleased to have visitors to the Land Show call and make inquiries concerning the company's holdings.

PROGRESS IN IRRIGATION.

Irrigation development in the San Antonio country has shown unprecedented growth in the past two years. There are now 82,700 acres under irrigation in this section and 48,700 acres available for irrigation that will be brought in in the very near future.

Reclamation Notes

CALIFORNIA.

Thirty thousand acres of land near Willows, in Glenn and Colusa counties, is being irrigated by pumping plants, and will be planted to rice before being placed on the market in small farms for homeseekers.

The Secretary of the Interior has awarded contract to Hard Brothers, of Concord, Calif., for the construction of Schedules 1, 2 and 3 of the earthwork of the distribution system of the Orland irrigation project. This contract calls for the excavation of approximately 58,000 cubic yards. The amount of the contract is $10,738.25. Work must be completed before April 1, 1911.

An eastern corporation, with headquarters at Omaha, Nebraska, has secured an option of 320 acres of land adjoining the tract they now own near Chico. It is the intention of the company to improve the land and colonize it with settlers from Kansas and Nebraska.

The Board of Supervisors of Colusa County have approved the petition which was presented by William Jeffreys asking for the formation of a reclamation district embracing his land near the town of Colusa. The district will contain 252 acres.

At a meeting of the San Joaquin Valley Conservation and Irrigation congress held at Los Banos late in October it was decided to prepare for the organization of an irrigation district under the Wright law, which will embrace all the lands of the San Joaquin basin proper extending from Tracy on the north to Kings river basin on the south, exclusive of the Merced and Tuolumne river basins, and embracing all

other lands which can be irrigated by gravity, the boundary line on either side of the valley to conform to a grade elevation of 40 feet above high water mark on the river in its respective latitude. The district embraces about 3,000,000 acres, and it is estimated that the cost of placing same under irrigation will not exceed $9,000,000.

An organization known as the Santa Fe Improvement Company, composed of Santa Fe Railroad officials and Los Angeles capitalists, are planning the construction of an irrigation project at Del Mar, near San Diego. Mr. E. S. Van Dyke, who is a pioneer student of irrigation in Southern California, has been commissioned to build the water system.

The Hutchinson Company, of Oakland, a contracting firm, has filed suit against the Patterson Ranch Company of Fresno, alleging that they have several thousand dollars due them for irrigation work on the ranch. The original contract was entered into in June, 1909, and called for the construction of canals, reservoirs, spillways, ditches, etc., on the Patterson property, work to commence July 1, 1909, and to be finished by December 1 of the same year. Later this contract was extended to May 21, 1910. Work was finished on May 16, 1910.

H. J. Gray, a contractor of Sacramento, has brought action against the Sacramento Valley Irrigation Company, for a judgment of $87,344.75 for work done and damages to the sum of $116,555, or a total of $203,899.75. Gray enetred into a contract with the Sacramento Valley Irrigation Company to build and construct various ditches and laterals in Glenn and Colusa counties, and he sets forth in his action that the irrigation company wilfully violated the terms of the contract in that it delayed and made work impossible because it neglected to indicate the work to be done by suitable stakes driven showing the "cut" and "fill" to be made at intervals along the lines of canals and ditches to be built.

H. L. Gradon, a civil engineer of Oroville, has filed a notice of location of 20,000 inches of water in Middle Fork of the Feather river, to be diverted just below the mouth of

Brush creek, to be used for power and irrigation purposes.

The Washington-California Investment Company, composed of Spokane capitalists, has purchased 690 acres of land near Corning, known as the Reid ranch, and will irrigate and colonize it.

At a recent meeting of 250 orange growers held at Covina late in October, Supt. J. R. Elliott of the Covina Irrigating Company stated that a project was well under way for the addition of 700 California miners' inches to the present supply, and the expenditure would be from $125,000 to $150,000. Two test holes will be bored, and if engineers report the location of water-bearing gravel, the wells will be sunk in this region and water lifted by steam or electric power. They also discussed the feasibility of establishing a dam site in the San Gabriel Canyon which would conserve enough of the storm waters to supply the entire valley, including the unirrigated 30,000 acres of the La Puente ranch. It is said that this project can be built for about $1,500,000. The matter was taken under consideration.

Work on the irrigation system started at Red Rock by the Union Land Company has been resumed and new canals are being built, and repairs made on the old reservoirs. Upwards of 30,000 acres of land will be reclaimed by this system.

The Mojave River, Land and Water Company of San Bernardino has filed on 80,000 inches of water and will irrigate several hundred thousand acres of land lying between Daggett and Otis. The appropriation covers both the surface and subterranean flow. A series of wells will be sunk in the Mojave basin, and water will be raised to the surface by means of electric pumping plants. A big dam will be erected across the Mohave river and from the lake which this dam will create, water will be distributed to the irrigation system from the lake to the lands to be reclaimed.

The Yucaipa Water Company has filed a trust deed by which all the land owned by that company in the Yucaipa

Company to secure a bond issue of $150,000. It is the intention of the company to build an extensive irrigation system with which to irrigate land in the Yucaipa valley, near San Bernardino.

The private irrigation system which has been constructed in Honey Lake Valley, near Amadee, is completed, and has been put in operation. This system is supplied with water from Honey Lake by a pumping plant, and provides water for 6,000 acres of land. The plant consists of a 150-horsepower gasoline engine and a pump capable of pumping 40,000 gallons per minute.

A suit which may involve over $1,000,000 has been commenced in the San Bernardino court by Attorney C. C. Haskell, acting for Joel Scott Wheeler, against the Rialto Irrigation district. The sum named in the suit is $3,333.70, alleged to be due on principal and interest of irrigation bonds issued under the Wright Act of 1887. The question involved is as to whether the district could use bonds in payment for a water system, which was to be constructed for the benefit of the ranchers. The Wright Act expressly states that district bonds can not be exchanged for work or labor.

The Sacramento Valley Irrigation Company has leased 1,045 acres of land near Chico and will irrigate it by pumping with electric power.

B. de la Beckwith has brought suit against the Sacramento Valley Irrigation Company, the Sacramento Valley West Side Canal Company and the Central Canal and Irrigation Company for the title to 46 miles of canals, water rights sufficient for the irrigation of about 300,000 acres, laterals, ditches, etc., together with a large acreage of land. The Sacramento Valley Irrigation Company is operated by the J. S. & W. S. Kuhn of Pittsburgh, Pa., and they have put over $3,000,00 into this undertaking through the American Waterworks and Guaranty Company of Pittsburgh. That company has issued bonds in the sum of $15,000,000 against the property involved and some $10,-000,000 worth of the bonds have been subscribed for. The validity of this bond issue is partly involved in the suit pending.

COLORADO.

Charges of mismanagement are made on a complaint filed in the district court by Edward C. Bryan, in which a temporary injunction is sought against the Orchard Mesa Irrigation Association and the Orchard Construction Company. The ditch has just been completed at a cost of $1,000,000, and Mr. Bryan, who owns forty acres, asks the court to prohibit further payment to the contractors, claiming that the contract has been violated and that the construction company has charged more for the extra work required than had been originally agreed upon.

Maps and statements have been filed in the county clerk's office for the Kersey canal, which has for its purpose the reclamation of 300,000 acres of land in Weld, Morgan and Washington counties. The irrigation system, when completed, will cost $1,073,540. Water will be taken from the Platte river, with head gates six miles east of Greeley. The main reservoir will be located at Home, fifty-five miles west of Fort Collins.

French engineers, representing French capital, have been in Weld county looking over the completed and projected work of the Denver Reservoir and Irrigation Company, and it is stated that if the report is favorable Paris capitalists are ready to take hold of the work and complete it.

Cassius Kerr, Michael Brady and Marion Stark of Monte Vista, as trustees, have received a deed for the entire holdings of the San Luis Land and Irrigation Company, and for the canals, ditches and water rights owned by the company, the consideration being $300,000 in bonds at par of the proposed irrigation district to be formed under the Terrace reservoir, about 20 miles from Monte Vista. The district will be known as the Terrace Irrigation District. It is the design of the promoters to organize the irrigation district under the state statutes, providing for about 35,000 acres, and issue bonds to the amount

of $600,000; $300,000 of which is to be used in completing the dam and ditch system. The present dam is over 100 feet high and will store about 8,000 acre feet of water. When completed it will be 219 feet high. The bonds will be twenty-year, bearing 6 per cent interest.

Engineer H. R. Oliver, of Fort Morgan, has completed plans for the building of a dam 65 feet high, 1½ miles above Fort Morgan, which will store 110,000 acre feet of water, which will be carried 98 miles to the Haxtun reservoir in the northwestern part of Phillips county, where a 19-mile canal will be built to distribute it. The Haxtun reservoir will contain 20,000 acre feet and will cost $150,000, the main canal $1,250,000 and the main reservoir $1,000 000. Denver capitalists are behind the project, which is considered one of the best propositions in Colorado.

A $3,000,000 bond issue has been voted by the East Denver Municipal Irrigation District, comprising 60,000 acres northeast of Denver, for the purpose of taking over the English High Line ditch, the Antero reservoir, the Terminal and Abbott sub-reservoirs, and completing the extensions of the main line ditch and laterals. The English High ditch was built 30 years ago, but was without an adequate water supply until the completion of the Antero reservoir last year.

A new irrigation ditch, which will make use of many smaller ditches when completed, will irrigate an immense acreage near Sterling, called the Sterling irrigation district. The Jackson and Riverside reservoirs, now supplying water to the North Sterling district, will be used by the new system as a storage point, and the ditches of the North Sterling system, to a certain extent, will be used as outlets for the water into the new West Sterling ditches. The lands which will be irrigated lie between the Pawnee ditch and the ditches of the North Sterling district, and one on higher ground. Under the supervision of State Engineer Comstock, the Riverside reservoir.

which will be used as a storing station for part of the water to be used in irrigating the West Sterling district, is being improved and the dam raised, all at a cost of $300,000. When completed the dam will have a storage capacity of 65,000 acre feet per year.

The engineers in charge of the Elk River irrigation project in Routt county have completed their survey, and state that the entire line will be very reasonable in construction considering the immense value of the tract of fertile land to be watered, reaching almost the entire length of the county. It is stated that the water supply is adequate for 200,000 acres of land. The land to be reclaimed lies in the west end of Routt county. It is claimed that $5,000 acres will be brought under cultivation in 18 months.

Julius Christensen, of Philadelphia, Pa., has purchased $1,000,000 worth of bonds of the Pueblo-Rocky Ford Irrigation Company. The proceeds of the sale are to be used in completing the first unit of the company's irrigation system which is to irrigate 150,000 acres of land in southern Colorado when completed. The company has an authorized capital stock of $2,000,000, and is also authorized to issue $2,000,000 of bonds. It is stated that water for the first unit of the land will be turned on the land in the spring of 1911.

County Judge Frank G. Merick has granted a temporary injunction to the Pueblo-Rocky Ford Land Company which restrains Paul Butler and Blanch Butler Ames or their agents from interfering with the work of the company in the construction of their irrigation ditch across the lands of the defendants. The land company asserts that they have been unable to secure a right-of-way through the land, which belongs to the estate of the late Gen. B. F. Butler of Massachusetts, and that it is important for them to proceed with the building of the canal in order that the water may be furnished next year. The land is owned by the defendants, according to the petition, is mostly a barren and rocky canyon, through which

the Huerfano river flows. One of the company's diversion dams is to be located at this point. Judge Mirick, in granting the injunction, required a deposit of $500 from the company to cover damages, and set the case for hearing on December 5th.

IDAHO.

The lien of Hales & Crane, sub-contractors on the Idaho Irrigation Company's works under the J. G. White & Co., Inc. (notice of the filing of which was given in our October issue), has been discharged, as final payment of all balances due Hales & Crane has been made. Hales & Crane filed this lien purely as a technical protection of their statutory rights until such a time as they could obtain proper release from one of their own sub-contractors, which was a condition precedent to their receiving final payment of the balance due them. We are informed that there never was any question of the amount of this balance due, and it was tendered when due, but Hales and Crane could not at that time show satisfactory release of all claims against them by their sub-contractors; consequently, payment was withheld until satisfactory release could be shown.

Rapid progress is being made on the Payette-Boise project, a government undertaking. The main south side canal is being lined with concrete.

(Continued from page 663.)

tion. The machine which we show at work in our photograph is adaptable for cutting canals of almost any width or depth. In our photograph it is shown pulled by teams, but a traction engine is also very convenient for operating it. Our photograph shows the extensive work on which this machine is successfully employed. It will handle about 1,000 cubic yards of earth per day, and this can either be loaded into wagons, as the picture shows, or discharged on the bank of the canal or ditch when used on such work.

This company also manufactures a small grader for cutting lateral ditches and keeping them clean. This machine is known as the Little Western Grader and Ditcher. It can be worked by one man and two horses with ease, but it is also

adaptable to four horses and two men when heavier work is demanded of it.

Visitors to Chicago for the Land Show should investigate these up-to-date machines if at all interested in irrigation work.

(Continued from page 652.)

good investment. The water from the reservoir was distrbuted to the different plats with no waste through 6-inch distributing pipes, and it has been shown that the economy in water amply justifies the expense of piping.

The results of the experiments made during tne season of 1909 show fully the great advantage of having a water supply for the irrigation of as large a part as possible of each dry farm, and that the use of storm and flood waters during the fall and winter for the irrigation of lands for which water is not available during the crop-growing season gives valuable results.

(Continued from page 646.)

and bounds. There is a big demand for irrigable land. The government, although spending about twenty million for irrigation now, cannot keep pace with the popular demand for irrigated land. Private capitalists are adding $100,000,000 to the reclamation fund. Ex-President Roosevelt, in a speech at Denver, August 29th, advocates the use of private capital in developing irrigation projects, as "the essential thing is to make homes on the land."

Irrigable lands cover a limited area. The yield seems unlimited. Pecos Palisades is a new irrigable district opening ahead of a railroad. The railroad is not there, but the irrigation system is, leaving a loop hole for profitable investment. Catch the idea? Count yourself fortunate for having requested my irrigation money-making series of pamphlets. It opens a new field to you. Your best investment opportunity is here presented. Tell your friends about this project. Industrious men and women are needed in the Palisades district to help build it up. Your opportunity is to get there ahead of the railroad.

EUCALYPTUS GROWING FOR PROFIT.

More or less information has been given to the public during the last two or three years with regard to eucalyptus trees, the rapidity of their growth and the lumber value of their wood. The public, however, has been slow to appreciate the value of this new timber. It has been growing over fifty years in California, where it was introduced from Australia. That a hardwood tree can grow to marketable size in ten years seems a thing incredible to most people who have not seen the eucalyptus with their own eyes. Many who have been convinced of the rapidity of the growth of the tree have formed the natural conclusion that its wood must be pithy and of little commercial value. The truth about this wood is that it is rapidly replacing all other hardwoods.

From three to five years of age Eucalyptus trees make excellent fuel, though they are rapidly becoming too valuable to sacrifice in this way. At from seven to nine years the wood of the tree is good for wagon tongues, insulator pins, agricultural implements and other rough usages. At from nine to twelve years of age the wood is superb for all hardwood purposes, and its durability and polish equals that of any hardwood grown in America.

As one travels through California today he sees on every hand groves of these trees; in fact, in the very heart of the old orange districts of the state valuable acreages are now planted to eucalyptus. The San Joaquin Valley, the great interior valley of California, has been demonstrated to be a superior locality for the growing of the best varieties of eucalyptus. Here are found the best of soil with the right climate and favorable conditions as to underground moisture for the production of these man-made forests.

The Porter Land Co., of Chicago, has several thousand acres of land in Tulare County, which they are planting in this way. This is the county in which the "famous big trees" have been growing for the last three thousand years or more. The conditions that have made it possible for these world wonder trees to flourish through thirty centuries or more are proved to be congenial also to the growth of the eucalyptus. If trees now planted can be spared the ax of the woodman, they would eventually overtake their aged rivals in height, if not in diameter. In fact, eucalyptus trees in Australia have been met with which exceed in height the "Famous Big Trees of California." There is no other tree that a man can plant and expect to harvest as lumber in his own generation. The most remarkable thing about the eucalyptus is that one harvest is not all; when cut, trees spring immediately from the stump and the second growth is even faster than the first. This process of cutting and regrowing goes on indefinitely.

(Continued from Page 662.)

"INCH."—

An "inch" in measuring water rights contemplates miner's measure under six-inch pressure. *Ison* v. *Sturgill*, Supreme Court of Oregon, 109 Pacific 579.

RIGHTS OF SETTLERS.—

A settler on the public domain acquires no right in waters of a stream diverted in excess of his actual use and needs. *Porter* v. *Pettengill*, Supreme Court of Oregon, 110 Pacific 393.

"INCH."—

The word "inch" as used with reference to water for irrigation purposes, is estimated on the basis of 40 inches to one "second foot." *Hough* v. *Porter*, Supreme Court of Oregon, 98 Pacific 1083.

ACTION FOR FAILURE TO SUPPLY WATER.—

An action by a land owner within an irrigation district against the district for damages on account of failure to supply water to which he was entitled is an action in tort, and not on contract. *Snake River Valley Irr. Dist.* v. *Stevens, Judge.* Supreme Court of Idaho. 110 Pacific 1033.

Laws 1907, c. 49, § 53, provides that, in case of seepage water from any constructed works, the owner of the works shall have first right to the use thereof on filing an application to the territorial engineer as in the case of an original appropriation, but if the owner shall not file such application within a year after the completion of the works, or the appearance on the surface of such seepage water, any party desiring to use the same shall make an application to the territorial engineer as in the case of unappropriated water, and shall pay the owner of the works a reasonable charge for storage and carriage of the water, provided the appearance of such seepage water can be traced beyond a reasonable doubt to the storage and carriage of water in such works. *Held*, that the term "constructed works" as so used referred to constructed reservoirs and ditches, not including a dynamited artesian well, and that the section had no application to seepage or spring water arising on the land of a proprietor from an unknown source. *Vanderwork* (*Territory of New Mexico, Intervener*) v. *Hewes*. Supreme Court of New Mexico. 110 Pacific 567.

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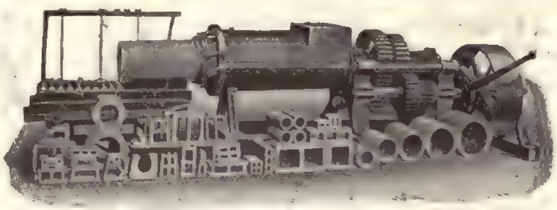
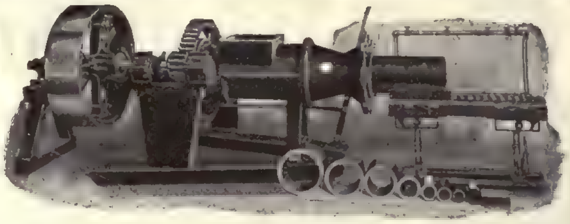


Centennial Auger Machine



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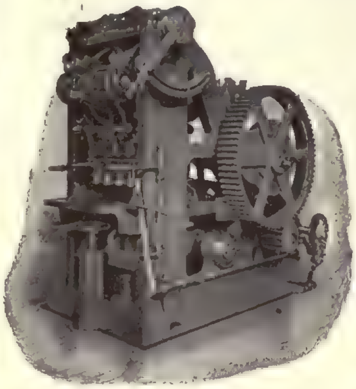

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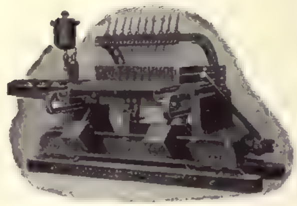

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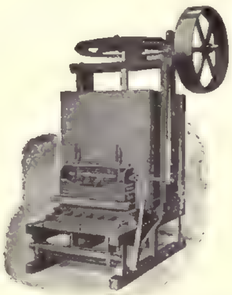

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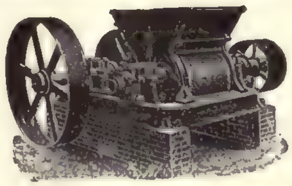

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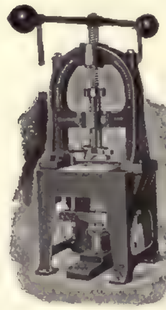
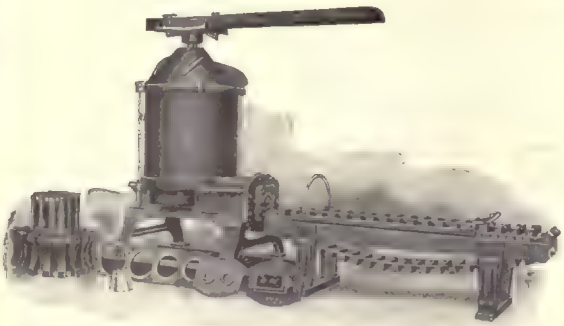


Hand Power Screw Press



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THE IRRIGATION AGE

VOL. XXVI — CHICAGO, DECEMBER, 1910. — NO. 2

THE IRRIGATION AGE

With which is Merged

MODERN IRRIGATION — THE DRAINAGE JOURNAL
THE IRRIGATION ERA — MID-WEST
ARID AMERICA — THE FARM HERALD

D. H. ANDERSON
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D. H. ANDERSON, Editor

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Official organ Federation of Tree Growing Clubs of America. D. H. Anderson, Secretary.

Official organ of the American Irrigation Federation. Office of the Secretary, 212 Boyce Building, Chicago.

Interesting to Advertisers.

It may interest advertisers to know that The Irrigation Age is the only publication in the world having an actual paid in advance circulation among individual irrigators and large irrigation corporations. It is read regularly by all interested in this subject and has readers in all parts of the world. The Irrigation Age is 26 years old and is the pioneer publication of its class in the world.

Interesting Statistics on State's Irrigation.

The Bureau of Statistics in the State of Washington has issued an important pamphlet on the subject of irrigation. A special feature of the pamphlet is a chapter devoted to irrigation in western Washington. The lands in Challam county, which are now being irrigated, are described in detail and the possibilities of future development are plainly set forth. Pierce county, where the prairie lands south of Tacoma are being developed under irrigation, is also given generous space and it will no doubt be a great surprise to many people to learn something of the possibilities of those lands when developed under irrigation.

A particularly interesting feature is found in a large number of reports secured from individual farmers and fruit growers. The experiences of these men are presented over their signatures, showing the various methods by which a living may be gained on orchard lands before fruit trees come into bearing. A great many also submit reports showing, for a given season, the results obtained from their land and the net profits arising from the sale of their products. There are suggestions in this for other state officials.

High Tribute Comes With Ballinger's Exoneration.

Every citizen who loves fair play will rejoice in the splendid tribute which came to Secretary Ballinger in connection with the congressional report which exonerates him from fraudulent or improper action in the conduct of his great office. The report was written by Senator Knute Nelson of Minnesota and was signed by Senator Root of New York and a majority of the investigating committee. It is needless to say that men like Senators Nelson and Root could not be induced to make a dishonest report either for or against an accused official, even one of their personal friends.

Nelson and Root are adherents of the Roosevelt element in the Republican party and hence would be apt to sympathize with Gifford Pinchot, former head of the forestry bureau, whom President Taft ousted on account of insolence, insubordination and general misconduct. Pinchot and two or three other discredited employes of the government started the war on Secretary Ballinger in connection with coal land entries in Alaska and certain questions of conservation, in which matters it was charged he had been dishonest as well as remiss in his duty as Secretary of the Interior. Here is the gist of the report to Congress:

> "No improper conduct on Secretary Ballinger's part has been shown nor any action by him not within the sound discretion of the head of the Interior Department in the faithful performance of his duty.
>
> "He is not an enemy of, nor hostile to, a reasonable and judicious policy of conservation, and no ground whatever has been shown justifying the opinion that he is not a faithful and efficient public officer."

This is vastly different from the tone of the many newspapers of Republican complexion which have for months been demanding the secretary's resignation. President Taft was determined to give Ballinger a square deal and has shown himself strong enough to stand up against the bitter attacks on the cabinet officer. The result, after a long and thorough investigation, justifies the president's manly action. It also reflects the infamy of many prominent American journals which tried, condemned and all but executed Secretary Ballinger on the

testimony of men who had been discharged from office for the good of the public service. President Taft's firmness and his determination to learn the truth in the face of savage newspaper opposition have raised him immeasurably in public estimation. The Ballinger case will have an important bearing on other cases in which sensational and unprincipled newspapers are seeking the ruin of public men whom they cannot control.

National Association of Land Men.

It was our intention to publish in the December number of THE IRRIGATION AGE, a full outline of the organization recently formed by leading real estate men throughout the United States, known as the National Association of Land Men. Owing, however, to the fact that preliminary work necessary to complete the organization was delayed until early in December, it was concluded better to wait until our January number and give a full list of the organizers, board of directors, officers, etc., also furnish information concerning articles of association. declaration of the purposes of the National Association of Land Men, and the By-Laws. This will all appear in our January number with information concerning the individual promoters of the proposition. The National Association of Land Men promises to be one of the finest and strongest organizations of its character ever attempted. In fact, it already has members in every state west of the Mississippi river, and many members throughout the south. As an illustration, one of the board of directors is an Oregon man, while a second is located at Brownsville, Texas.

A copy of the Charter of this organization, together with other literature, will be sent to any one interested on application to the secretary, 112 Dearborn street, Chicago, Illinois.

The Primer of Hydraulics.

The publisher of THE IRRIGATION AGE is pleased to announce to its readers that arrangements have been perfected with Mr. Frederick A. Smith, a noted hydraulic engineer, whereby THE IRRIGATION AGE has obtained the sole right to publish a treatise on hydraulics designed and arranged by Mr. Smith after twenty years of practical experience in this line, and this present issue of IRRIGATION AGE contains the first installment.

It is the plan of the publishers to give an installment of this work monthly for about one year, after which the whole book will then be completed and put on the market.

As the title indicates, it is to be a Primer in Hydraulics, designed to give the principles of the Science of Hydraulics in a popular form, so that men of an ordinary education will be able to not only grasp these principles, but to also apply them to practical problems. The book will in all respects be a successor to the "Primer of Irrigation," issued several years ago, excepting that it will contain much more technical matter necessary for a proper understanding of the subject. The matter is arranged in a progressive way, introducing the reader gradually from simple to the more intricate principles, and the work will consist of original matter throughout.

This is the first book on hydraulics ever published which will give the layman an opportunity to grasp this subject as the difficult and cumbersome formulas usually found in books of this kind have either been eliminated, transformed, or have been made of such easy application that their use has been greatly simplified.

The publisher hopes that the readers and patrons of THE IRRIGATION AGE will find this expansion of their publication of service to them and that they will assist in spreading this good news to their friends and acquaintances, as a good knowledge of hydraulics is essential to good irrigation.

Prospects Better for Irrigation Bond Issues.

The general outlook for the better class of irrigation bonds has greatly improved. Buyers are turning away from low-priced issues of all kinds, and while they are no less discriminating than ever their demand is for bonds of high earning power. This is a feature of the momentary situation the world over and all governments have had to take notice of it.

Irrigation bonds as a rule are returning five to six per cent, and it is apparent that capitalists will be insistent on at least a six per cent basis. At such a figure there is likely to be a good market during 1911, for money is easier and is likely to remain so for some months to come.

Secretary MacVeagh seems to have been forced to the conclusion that the money markets of the whole world are turning away from extremely low-priced bonds. He has been studying the question specially with a view to the market value of the Panama issue, which he has authority to sell at a rate not exceeding three per cent. He finds it a difficult task to interest capital. It is probable, judging from the facts brought out, that the secretary perceives a new and higher level for investment securities, particularly in the United States, and it is believed the day has gone by when this or any other government would undertake to dispose of a two per cent bond.

British consols, which are a permanent debt, yielding 2½ per cent, now sell at 79, a price which yields an actual return of 3.16 per cent; the German Imperial 3 per cent bonds sell at 83, a price which yields 3.61 per cent; the French 3 per cent rentes sell at 97.97½, a price which yields 3.06 per cent. Whether or not the credit of the American Government, when divorced from the circulation privilege, is substantially higher than that of the three countries mentioned, and to what extent it is higher, are the questions now under investigation in the Treasury. Secretary MacVeagh is strongly of the opinion that the Panama bonds ought to be issued at a rate at which they might be absorbed by investors for their earning power without regard to any especial privilege. He realizes that the year 1911 will not be a period particularly favorable to the flotation of low-priced securities.

Every bond dealer in Chicago is looking for a better market with the opening of the year. Easier money is practically assured and it is thought there will be a few months of great activity in securities representing high-class real estate enterprises. A surprise is in store for any financial man who will gather up specimens of the new bond literature which is in circulation. It indicates a big campaign on new lines. There never has been a time when real estate and industrial bonds were made to appear so attractive. Many of the safest propositions are represented by issues returning six per cent or better. There is a valuable suggestion in this situation for companies handling irrigation securities.

Patrons Save Poorly Managed Exhibition.

The great land show has come and gone, leaving an unpleasant suggestion of incompetent management. The exhibition was a success because its patrons made it so despite the narrow policy of those in charge. The many who paid exorbitant rentals and thousands of visitors who had their eyes opened to the situation resolved never again to patronize one of these individually conducted shows.

In spite of all, the exhibits were good and the attendance was large. It is a pity that such an enterprise could not have been conducted by some responsible association instead of by one publication, which had no higher purpose than an advertisement for itself and the return of some cash revenue.

There was a vast assemblage from day to day of intelligent, progressive people, who proved by their patronage that they are ready to support an educational project of this character. The demand for a permanent land show is plainer than ever, but it will be necessary to organize along different lines.

The exhibitors made the land show a means of education so far as progressive agriculture is concerned. It was a powerful argument in behalf of irrigation.

The one fact which predominated and impressed itself on every mind was that intelligent effort and the adoption of modern methods are as important in farming as in anything else. Whether it be in selecting a location or conducting a fruit or grain farm it pays to use the head as well as the hands. It pays to give respectful attention to the teachings of science.

Of course, the exposition was in a large degree western, for it is in the newer western states that we find irrigation principles applied in the broadest way. Farming is most progressive in the far west. It is conducted as a rule by men who admit the benefits of scientific farming. As a result we have the amazing collection of fruit and cereals which were displayed at the land show.

It was apparent to all observers that the persons most impressed by the splendid illustrations of modern, intensive farming methods were the residents of the middle western states. In this section, of which Chicago is the metropolis, agriculture is in a backward condition. The farmers in this locality realize that they are behind the times and hence their interest in those features of the land show which illustrate the ideas of their more progressive western brethern.

The miniature irrigation plants were specially interesting and instructive, and it was made clear to the public that irrigation principles are as much needed in the central west as anywhere else.

Irrigation from all parts of the West gave practical exhibitions which were more than ordinarily praiseworthy. illustrated the pumping of the water and its distribution over the land by canals, ditches and laterals, while by personal explanation and printed articles gave the information needed by the public. On all hands there was a wonderful showing of agricultural products to prove the merit of this entire principle. The educational value of the exposition cannot be overestimated. Tens of thousands who realize the shortcomings of old methods in farming were benefited by this revelation of what irrigation and intensive methods mean to American agriculture.

FROM SECRETARY BALLINGER'S ANNUAL REPORT.

Irrigating Indian Lands.

There are large areas of irrigable lands within Indian reservations in the arid and semiarid regions. It is important to protect the water rights of the Indians and as rapidly as possible irrigate and reduce to cultivation such areas as are needed for the support of the Indians. Many of the Indians have not reached the stage of industry and efficiency sufficient to successfully conduct irrigated farms, nor can they be educated along these lines until provided with the water to irrigate their lands. Furthermore, it is believed that the advancement and education of the Indians along this line may be aided by leases of irrigated lands within reservations to the whites under conditions insuring the permanent attachment of a water right to the lands for the future welfare of the Indian, which can only be accomplished through beneficial use of the water. The leases should be made in reasonably small tracts for long terms, the maintenance charges for the irrigation system to be paid by the Indian leasing the land, and the whites so colonized that their agricultural operations will be an object lesson in industry and successful farming to the Indians on the reservation.

All purchasers of Indian lands under constructed irrigation systems should be required to pay a fixed maintenance charge, based upon the irrigable area of their lands, whether they farm same or not. They should also be required to pay their proportionate cost of the construction work performed upon the system subsequent to the date of their purchase.

Up to the present time about 300,000 acres of land in Indian reservations have been reclaimed by irrigation works, of which amount 118,640 acres are being irrigated by Indians and 42,080 acres by white lessees and purchasers. The area which will be irrigated when contemplated amounts to approximately 1,100,000 acres. The total appropriations for irrigation purposes during the past year amounted to $1,365,000. By act approved June 25, 1910, Congress authorized the Secretary of the Interior to reserve from location, entry, sale, allotment, or other appropriation any lands within Indian reservations valuable for power or reservoir sites, or which may be necessary for use in connection with any irrigation project. This authorization will be of great value in providing for and accomplishing the irrigation of arid Indian lands.

SAFETY OF AMERICAN INVESTMENTS IN MEXICO.

American capitalists declined to take alarm over the rebellion in Mexico. Stocks were but little affected by the talk of international complications. This is owing to confidence in the Diaz government, which is fully capable of discharging its duties and which is friendly to the people and capital of this country. It is supposed the uprising has been suppressed.

By venturing to attack American properties the Mexican revolutionists would take the quickest method of forcing the United States to intervene and thus check their plans. Every effort was put forth by our government to maintain strict neutrality, as there is no desire to interfere in any way with the internal affairs of the Southern republic. But this attitude would not prevent our government, or indeed any other power, from taking the necessary steps to protect the lives and the property of its citizens. This knowledge may, therefore, act as a deterrent upon those possessed by an anti-American sentiment. President Diaz can be depended upon to do everything possible to safeguard Americans and their interests in his country, as he has consistently demonstrated his willingness to handle American questions with every fairness.

American bankers and others have immense interests in Mexico and they have received assurances that the worst is over. No reports of injury to American enterprises have come to hand, nor is it believed that anything serious will occur. American capital has been devoted in Mexico mainly to the development of the transportation system.

ARID AGRICULTURE

BY

B. C. BUFFUM, M. S.

Manager of the Wyoming Plant and Seed Breeding Company, Worland. Former Professor of Agriculture in the University of Wyoming and the Colorado Agricultural College, and Director of the Wyoming Agricultural Experiment Station.

ALFALFA HAY CULTURE.

Prof. B. C. Buffum.

Alfalfa is an intensive culture hay. The plant is worth all the work and attention given it. It responds to careful, persistent, attention. The fact that it is easy to grow should not make the farmer careless. The profit in any kind of farming does not lie in average crops, but in producing more than average crops.

PREPARATION OF LAND FOR ALFALFA.

Sowing alfalfa in the sod or on sod land seldom results favorably. Alfalfa seed has become scarce and expensive and should never be wasted or thrown away in a poor seed bed. New land should be cultivated in some other crop at least one year before it is seeded to alfalfa. The seed bed should be moist and well packed. On this account it is advisable to plow in the fall. Where irrigation is practiced too much care cannot be given. The careful leveling and smoothing of land which is to be seeded to alfalfa is necessary. The crop is to remain on the soil for from two to ten or more years, and avoiding future expense of difficult irrigation will pay many times over. It is well carefully to level the ground and then try it by giving a flood irrigation before the seed is planted. If there are holes or bumps which are hard to irrigate, go on again with the Fresno scraper, land grader or home-made leveler. Either irrigation or sufficient length of time and attention given to conservation of moisture should always be practiced before planting alfalfa seed. It is important that there should be enough moisture in the soil to germinate the seed and give the plants their first few weeks of growth until they get eight or ten inches high before another irrigation becomes necessary.

TIME TO SOW ALFALFA.

Where the seasons are short alfalfa should be sown as early in the spring as the ground can be put in proper condition and heavy freezing weather is past. The young plants are not seriously injured by a few degrees of frost. At lower altitudes where the season is longer alfalfa may be sown any time up to the middle of August. As far north as northern Wyoming we have succeeded in securing a good stand of alfalfa where it was planted as late as the last of August.

SEEDING ALFALFA FOR HAY.

Use a drill. Use a drill with press-wheel attachments. Do not sow broadcast unless only an acre or so is planted and a drill cannot be obtained. Plant the seed shallow—from one-half inch to two inches deep. The amount of seed to use will depend upon circumstances. If the seed-bed is in perfect condition, moist, loose on the surface, firm below and warm, from eight to twelve pounds of good seed per acre will produce a sufficient stand. Usually the seed-bed is not in good condition and twenty pounds of seed per acre is recommended. The more seed the finer the hay, other things being equal. Some growers, especially in the Eastern states, plant as much as thirty pounds or forty pounds of seed per acre. The method the author has recommended to growers is to sow ten or twelve pounds the first year, and if a heavy stand is not secured, go over the second season in the opposite direction and drill in ten pounds more of seed. This reseeding should be done the first or second year, as after the old plants get well established the young ones are shaded or crowded out, and never make a good, thrifty growth. Seed at right angles to the direction of the wind. Under irrigation it is best to seed with the direction of the land slope, unless the land is so steep the soil will wash.

PLANTING WITH NURSE CROP.

It is common practice to sow alfalfa with some nurse crop, as no return can be expected from the alfalfa the first year. When this is properly done, a nurse crop is not especially objectionable, as a stand will be secured which will produce hay the second year. Better results are always obtained without a nurse crop. The plants become stronger and will produce heavier crops of hay the second year where they have the land all to themselves from the time of planting. The best nurse crops are those grains which produce the least leaf growth or stool the least, or mature in the shortest season. Macaroni wheat is better than other wheat. Wheat or barley is better than oats. If grain is used as a nurse crop, plant it thin, using only half or two-thirds the seed used if planting without alfalfa. Winter grains may be used as nurse crops by harrowing in the spring and sowing alfalfa early, before they have made large growth. These crops mature early in the summer and leave considerable season for the alfalfa to establish itself after they are removed.

CULTIVATION OF HAY.

If any cultivation is attempted the first summer it must be carefully done. Young alfalfa plants are very tender. At the end of the season, however, a light harrowing crossways of the drills may do more good than harm. If weeds are thick, they should be mowed before

The "Go Devil" and Stacker Putting Up Alfalfa.

there is danger of smothering the young plants; but do not cut close to the ground. An excellent practice is to apply a thin coating of manure with a spreader over the alfalfa field in the fall, either for new or old planting.

It is only recently we have discovered the great profit arising from cultivating alfalfa fields. There are two indispensable implements for alfalfa cultivation; the disc, or the spiked-tooth alfalfa harrow, and the drag harrow. Cultivation should begin in earnest in the spring of the second season. If the disc is used, set the blades fairly straight. Weight the disc so that it will cut two or three inches deep. Lap it each round to leave the ground level, and do the work thoroughly. The alfalfa spiked-tooth harrow does not ridge the land like the disc and does not split the crowns of the alfalfa plants. It digs up the soil deeper, and does excellent work in loosening and aerating it. If the soil is left lumpy, follow with the drag harrow to finish the work. This cultivation should always be done in the early spring; it may be done in the fall and winter, and in many localities will pay after each cutting, providing there is time after irrigation and before the plants get too high. Such cultivation lets air into the soil, saves moisture, kills weeds, destroys insects, makes plant food available, increases the crop.

INOCULATION.

In most of our western soils alfalfa will not need artificial inoculation. By inoculation we mean supplying the bacteria which live on alfalfa roots and gather nitrogen

from the air. Alfalfa will live without the presence of these bacteria, but it does not do well These bacteria produce little nodules or tubercles on the roots, take the nitrogen gas of the air and change it into nitric acid, which in turn becomes valuable plant food, and the kind most needed in the West. Where alfalfa plants do not thrive, look yellow or appear to be in a dying condition, it is usually due to the absence of nitrogen bacteria. Artificial inoculation material has been on the market, but it has so generally failed that farmers should not spend good money for such cultures. A practical method of inoculation is to take soil from an old alfalfa field or from a place where sweet clover is growing and sow it over the field to be inoculated. A thin sowing of a few pounds per acre will get the bacteria started, after which it will increase and spread. We have sent such alfalfa soil in four-pound packages by mail to farmers, who have changed their success with alfalfa by sowing upon and harrowing it into their fields.

ALFALFA MIXTURES.

On many farms of the West sowing some grass with alfalfa is giving excellent results. Four grasses are used for this purpose, and we recommend a fifth. The four commonly used are timothy, brome grass, orchard grass or meadow fescue. In places, no doubt, the slender wheat grass will give as good or better results than any of the foregoing. The method is to sow the ordinary amount of alfalfa seed and then put on from ten to twenty pounds of the grass selected, and harrow it in. These grasses which grow tall enough will head just above the alfalfa, and it is claimed fields produce as large crops of both alfalfa and the grass used as would be grown if each were planted alone. Such alfalfa and grass mixtures make excellent stock feed, especially for fattening, as the grasses widen the ration. Mixtures of this kind are not recommended for dry farming. Grass sod in alfalfa shortens the life of the alfalfa plants and prevents thorough harrow cultivation.

IRRIGATION OF ALFALFA HAY.

Irrigate the ground before planting. Do not irrigate the seed up if it is possible to avoid it. Do not irrigate alfalfa when too young, unless you know it is burning. Many practice irrigating old fields early in the spring before the alfalfa starts, but this is probably not the best practice. Fall or winter irrigation is better. Alfalfa may be winter killed if irrigated so late that the water freezes around the crowns of the plants. If the water is absorbed by the soil so that it does not stand and freeze, no damage will be done, or if the ground is thoroughly frozen and the water merely forms ice over the surface, it does not harm the plants. Usually the first crop can be produced without irrigation; but alfalfa should be irrigated for each of the second, third and fourth crops. Some farmers practice irrigating just before cutting the hay. Irrigating at that time leaves the ground damp, which interferes with mowing, makes the hay more succulent and delays curing, which may cause injury to the hay. It does, however, put moisture in the ground, where it produces a quick and vigorous start from the crowns for the next crop. Alfalfa should be cut, cured and removed from the ground as quickly as possible. Then irrigate after the cutting. It is easier to spread water on the stubble. The irrigation can be done better and does not interfere with making the hay. Alfalfa does not stand well in water. The irrigations should be as short as possible. Some of the best farmers in the West now practice furrow irrigation for alfalfa. The furrows are made with a corn marker or something of the same kind. They are usually shallow furrows, four or five inches deep, and made two feet apart. Running water through these furrows prevents flooding the crowns, and on many soils better crops are produced.

HARVESTING HAY.

Alfalfa for hay should be harvested when it first begins to come into bloom. The best haymakers rake their alfalfa either immediately after mowing or as soon as it is slightly wilted. Some keep their hay in wind-rows; others bunch with a rake. Undoubtedly the best method, although it takes more work, is to put the hay in cocks with a fork, as it saves much waste and insures the best curing. The hay should be stacked when it is sufficiently dry, but not too brittle. Do not put in stack when there is dew, rain, or other moisture on the outside of the stems and leaves. If perfectly dry outside, it may be stacked when there is considerable moisture in the hay, providing the stacks are not made too large or stack ventilators are used. Always use some kind of stack bottom, even if it is no more than a layer of straw. On large fields many use the common go-devil, or ricker, to haul the hay cocks or bunches to the stackers. Mr. Wilcox has called attention to the Lockhart drag as an advanced method of hauling hay from the fields to the stack. This drag is made of nine 1x6 boards placed six inches apart and bolted at each end to 2x4 crosspieces laid flat. It is simply dragged over the field and a ton or more of hay tipped onto it with forks and then dragged to the stack, where the hay is delivered to the stacker. New stacks, especially where the wind blows, should be anchored by wires over the tops and fastening weights to them.

HARVEST AFTER ANY INJURY.

Do not hesitate about or delay the cutting of alfalfa at any time if its tops are injured severely by frosts, or hail, or insects, or drouth. It never pays to leave such injured alfalfa with the hope that it may recover, because the plants always make a second growth from the crowns, and the injured tops both spoil the hay and interfere with the growth of the second crop.

STORING GREEN ALFALFA.

Green alfalfa may be stored either in the silo or by a new method recommended by the Kansas Experiment Station. We do not recommend silos for the West, because dry alfalfa hay is such a perfect food that there is no necessity of putting it up green. The Kansas method of storing green alfalfa is of interest. The alfalfa is hauled in as soon as possible after cutting and stored on floors two to three feet above ground, made of poles or slats, which supply openings through which the air from beneath can pass up through the hay. These sheds are covered with some kind of roof. The alfalfa is piled from three to five feet deep on the floors, and if the weather is dry and there is no outside moisture on the stems or leaves, it is claimed it will cure perfectly without heating. Such hay contains all the leaves and retains a perfect green color, which gives it the highest value. Care must be taken not to compact the hay after it is put in.

Blooded Rams on Alfalfa Pasture.

ALFALFA AS A FERTILIZER.

Any one who has had experience or who has studied alfalfa in its relation to western soils becomes most appreciative and enthusiastic about its unparalleled value. Through the agency of the bacteria on its roots, alfalfa is one of the strongest nitrogen gathering plants. It grows from a large, strong tap root, which reaches the lower depths of the soil, bringing up plant food from the sub-

soil, loosening compacted soils and adding vegetable matter through their own decay when the soil is used for other crops. In growing several crops in a season, which are harvested as hay, there is a considerable deposit on the surface of broken off leaves, small stems, and more especially of stubble, which dies each time from the place cut by the mower to the crown of the plant. These things add much vegetable matter to the surface of the soil. Our studies have convinced us that growing alfalfa on any soil from three to five years adds from thirty to forty dollars worth of available fertilizer when it is plowed up for the production of other crops. By using alfalfa in rotation the raising of intensive crops, like potatoes and sugar beets, is made possible, and rotation with alfalfa in parts of the West has increased the average wheat yields from less than twenty bushels per acre to approximately fifty bushels per acre. Every farmer who can grow alfalfa, whether or not he may use the hay for stock feed, should consider this plant the foundation of his rotations in soil culture.

When used as a fertilizer many farmers simply leave the alfalfa two years. The alfalfa products themselves are so valuable that in most places when a good stand is secured it will pay to let it occupy the ground from three years to seven or eight years, or even much longer periods.

PASTURING ALFALFA.

There is objection to the use of alfalfa as pasture for three important reasons. First, sheep or cattle pastured on alfalfa are very apt to bloat. The way pasturing is usually done there is a loss of animals, which may make it unprofitable. Sometimes alfalfa hay will cause bloat when overfed to sheep and cattle. The cured hay at high altitudes where the stems are fine and there is a large percentage of leaves is more apt to cause bloat. Undoubtedly the best method of feeding green alfalfa is by soiling, in which the alfalfa is cut and carried to the animals each day.

The second reason for not pasturing alfalfa is that it injures the plants. Tramping and packing the ground by stock, more especially in regions where alfalfa is hard to grow, may cause more damage than profit from the pasture. This can be largely obviated by cultivation.

The third reason for not pasturing alfalfa is that it does much to foster and spread alfalfa diseases. One of the best remedies for our more serious alfalfa diseases is discing and aerating the soil. When soils have been compacted by heavy tramping, those bacteria and fungi which produce disease find conditions most favorable for their development and do the most serious damage.

Notwithstanding these objections, much profitable pasturing of alfalfa is done. Many large ranch and range men leave the last crop to be fed off by their stock in the fall and early winter. By proper management there need be little or no loss from bloat. Sometimes the alfalfa is allowed to become more or less cured and sheep or cattle are never turned on when hungry so they will gorge themselves. They should be well filled with other roughage, and after turning them in the alfalfa fields they are left there continuously. Moving them off and on to the alfalfa will cause serious trouble. Horses, swine and poultry may be pastured on green alfalfa at any time.

VALUE OF DIFFERENT CUTTINGS.

The first crop of alfalfa hay is always prized as the most nutritious and valuable. It contains less moisture, becomes better matured and undoubtedly makes the best hay for horses. Some Colorado lamb feeders say the best cutting for lambs is the first, the next best is the third cutting, and the second cutting is poorest of all. The third cutting is most succulent and the best for cows giving milk.

ALFALFA PRODUCTS.

Recently the alfalfa meal industry has become a large and important one. Alfalfa is so rich in food elements that it practically becomes a concentrate when reduced to the condition of fine meal. This alfalfa meal is mixed with other things to make complete rations. It is mixed with molasses from the beet sugar factories, and sometimes called "Alfalmo." Sugar beet molasses is a carbohydrate which widens the ration and gives excellent results. The finer alfalfa meal or flour is put up in boxes and sold for poultry breakfast food. Alfalfa meal is mixed with seeds and grains for poultry, with other grains for balanced rations for hogs; still others for horses and for cows. It is probable that the hay itself will give almost as good results for cows or other animals which need roughage for stomach distention, although it is claimed that alfalfa meal does not pack in the stomach. Some recent experiments in Pennsylvania show that if bran can be obtained for $20 per ton and alfalfa costs $22 per ton, it is probably more economical to feed bran. Alfalfa meal has high value for dairy cows, and it is economical if the cost of the meal is not excessive.

WATER FOR TIETON UNIT OF YAKIMA IRRIGATION PROJECT TO BE FURNISHED IN 1911.

The Secretary of the Interior has issued a public notice to the effect that water will be furnished from the Tieton Unit of the Yakima irrigation project, Washington, under the provisions of the Reclamation Act, in the irrigation season of 1911. This water will be furnished for the irrigable lands in private ownership, including State and railroad lands, and also lands heretofore entered (except tracts rendered vacant by the conformation of any prior entries to the farm units) shown on the farm unit plats of

Township	13	North,	Range	17	East
"	13	"	"	18	"
"	14	"	"	16	"
"	14	"	"	17	"
"	14	"	"	18	"
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Willamette Meridian.

The building charge is $93 per acre of irrigable land. payable in not more than ten instalments, each payment not less than $9.30 or some multiple thereof per acre. Full payment may be made at any time of any balance of the building charge remaining due after certification by the Commissioner of the General Land Office that full compliance has been shown with the requirements of the law as to residence, cultivation, and reclamation.

The operation and maintenance charge for the irrigation season of 1911, and annually thereafter until further notice, is $1.50 per acre of irrigable land, whether water is used thereon or not. The first instalment of the building charge is due and payable April 1, 1911, and the instalment for the year 1912 and subsequent years will be due on April 1 of each year until fully paid. Water right applications filed in 1912 and subsequent years must be accompanied by payment of all instalments for building, operation and maintenance which have become due and remain unpaid for prior years. The regulation is made that no water will be furnished in any year until all operation and maintenance charges levied for that year and for prior years shall have been paid in full. It will not be possible, therefore, for irrigators to obtain a water supply for the season of 1911 for any lands until that portion of the instalment for operation and maintenance due on April 1, 1911, has been paid. All charges are payable at the local land office, North Yakima, Washington. Failure to make any two payments of instalments of charges when due will render the water right application subject to cancelation, with forfeiture of all rights thereunder as well as of any moneys paid thereon.

THE PRIMER OF HYDRAULICS*

By FREDERICK A. SMITH, C. E.

Introduction.

Everything round about us which makes its presence known to us by acting upon our senses is called *Nature.* Thus nature is the sum total of everything capable of making an impression upon the human senses. It may be divided into two large subdivisions, namely, *Things* and *Phenomena,* and the knowledge of them is called *Natural History* and *Natural Science* respectively; thus the knowledge of animals, vegetation and minerals is called Natural History, subdivided into *Zoology, Botany* and *Mineralogy.* The knowledge of phenomena, such as the flowing of water in a river, or the freezing of water, or the rusting of iron and the growing of vegetation, *is* called *Natural Science.* The many thousands of phenomena in nature can be divided into two great classes. The one class embraces phenomena which do not change the constitution of the things upon which they are observed; for instance, the sounding of a bell, the breaking of a glass, the falling of an apple, the melting of wax, the boiling of water, are all phenomena which do not change the character of the substances involved; thus the bell is still a bell after sounding; the broken glass is still glass, the apple is still an apple after its fall, the wax is still wax after it is melted and the stream is still water after condensation. Such phenomena are called *Physical Phenomena* and the science teaching their knowledge is called *Physics.*

The other class of phenomena always produces a change in the affected bodies; for instance, if a copper coin is immersed into nitric acid there will be observed an intense action, the fluid turning green with a rising of brown vapor, and if enough nitric acid is used the entire copper coin disappears; if the green liquid is boiled down crystals of a green substance appear, which are neither copper nor nitric acid, but is a new substance called copper nitrate; thus the phenomenon has changed the constitution of the copper as well as that of the nitric acid; such phenomena are called chemical phenomena and the science treating of them is called *Chemistry.* Some other chemical phenomena are, for instance, the rusting of iron, the burning of wood, and the various processes of life in animals and plants, the manufacture of glass, reduction of ores, etc.

From the foregoing it is apparent that the phenomena of Hydraulics, upon which this work will treat principally, belong into the field of Physics, as the action of the forces which produce pressure and flow in water and other fluids does not produce a chemical change in its constitution. As this book is intended to treat the subject of Hydraulics in a practical way, adapted to the needs and capacities of the practical men who follow the various application of Hydraulics, the author will devote some time to the most important elementary principles underlying this subject, as an understanding of them is necessary for the comprehension of Hydraulics and its application to practical problems.

Art. 1. General Properties of Matter.

Everything which possesses weight is called *matter.* Even the lightest substance known, Hydrogen Gas, has weight, but one cubic inch of Hydrogen Gas weighs only the 11,000th part of a cubic inch of water, and a cubic inch of air is nearly 14½ times as heavy as a like quantity of Hydrogen Gas.

Following are the general properties of matter:

1. *Extension.* This means that all matter requires space for its existence. This is self-evident.

2. *Impenetrability.* This means that two bodies cannot occupy the same space at the same time.

3. *Divisibility.* This means that all matter can be divided into smaller parts; the truth of this is also self-evident. Thus if we crush a piece of chalk until it is a fine powder and look at it through a strong microscope, we observe that the apparently fine powder is composed of lumps of different forms, and though we are practically unable to break them into smaller parts, we can readily imagine that such division can be carried on much further. By the same process of reasoning a limit of divisibility must, however, be reached some time, or, with other words, there must be a smallest particle of every kind of matter. Such smallest particle is called a *Molecule,*

Some kinds of substances are composed all through of just one kind of matter; for instance, the diamond, which is pure carbon, while other substances are composed of two or more kinds of matter, as, for instance, water. Bodies composed of but one kind of matter are called *Elements,* while such bodies as are composed or two or more elements are called *Compounds.* If the divisibility in an element is carried on in imagination until the smallest particle is reached, then we are face to face with the *Atom;* hence an atom can be defined as the smallest particle of matter which can be divided no further. On the other hand, the smallest particle of a compound, the molecule, can be divided into the elementary atoms composing it. For instance: Water is composed of two elements, Oxygen and Hydrogen, and it may be decomposed by an electric current into these two elements; when this is done the Hydrogen gas appears on one electrode and the Oxygen on the other; also the volume of the Hydrogen gas which appears in tube B, Fig. 1, is equal to twice the volume of the Oxygen rising in tube A; this shows that for every atom of Oxygen there are two atoms of Hydrogen in a molecule of water. The elementary atom is represented by a symbol,

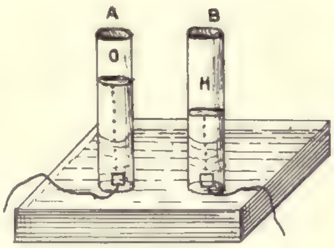

Fig. I.

the letter "O" in chemical lore represents an atom of Oxygen the letter H represents an atom of Hydrogen, so that the chemical symbol for water is H_2O, which means that the molecule of water consists of two atoms of Hydrogen and one atom of Oxygen. This symbol also tells the weight relation between the two elements, which is done by a table of atomic weights in which the relative weight of the various elements are compared with that of Hydrogen, whose weight, being the lightest substance known, is taken as unity; thus the atomic weight of Oxygen is 16, which means that the Oxygen atom is 16 times heavier than Hydrogen. This then gives the information that if, for instance, 9 pounds of water are decomposed into Oxygen and Hydrogen, we obtain 8 pounds of Oxygen and one pound of Hydrogen.

Water has purposely been chosen as an example, as this work will deal principally with water and its properties, and therefore the reader should increase his knowledge constantly in this direction.

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4. *Porosity.* This means that the atoms or molecules composing any body do not touch each other; but are separated from each other by vacant spaces. That this is so is plain, from the fact that the size of any body will change under certain conditions without changing the amount of matter in the body. Thus in Fig. 2 in the square A B C D is shown an aggregation of 16 atoms, having spaces between them representing the pores, which is the property of porosity.

5. *Expansibility and Contraction.* These two properties mean that the volume of bodies under the influence of certain forces may increase or diminish. The forces producing such changes are variations in temperature and pressure. Thus if a bar of iron is heated it expands in length as well as in width, and if in Fig. 2 A B C D is considered a square plate of steel which under the influence of heat is expanded to the size E, F, G, H, it is plain that as the weight remains the same, the number of atoms has not been increased and it is the pores which have become larger or, with other words, the particles have moved away from each other. This same effect may be produced by applying external force tending to pull the molecules or atoms away from each other.

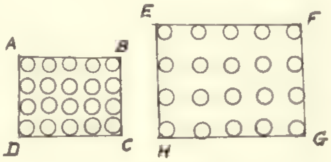

Fig. II.

The reverse phenomenon or contraction takes place when a drop of temperature occurs, or when the body is subjected to pressure, tending to force the particles together. This is seen in Fig. 2 when considering the atoms in E F G H, moving closer together when the volume decreases, as indicated in A B C D.

6. *Indestructibility.* This general property of all bodies means that no matter can be either destroyed or created, and that the total sum of atoms in nature remains unchanged. That this is so is perhaps not always easily seen, but a little study and thought will always confirm this statement. For instance, if a ton of coal is burned the residual ashes may weigh only a few hundred pounds; what has become of the remaining matter? Chemistry proves that the remainder has been converted into volatile substances which have passed off in the form of smoke and vapor, and that there has nothing been lost; the hydrogen contained in the coal has been combined with the oxygen of the air to form water, and the carbon has united with other portions of the oxygen of the air to form carbon dioxide, both combustion products being in the form of an invisible vapor have passed into the outer air.

But there is no particle of matter ever lost in the economy of nature, and the different elements merely change position when going through chemical or other changes.

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The American Engineering Corporation has been organized to conduct a general engineering business along broader lines than are open to the individual engineer. The Corporation commands the services of experienced engineers, and is prepared to undertake work in all branches of engineering. Engagements will be accepted without limit as to locality, and the corporation is ready, not only to act in the capacity of engineer, but also to take charge of development and construction work from inception to completion.

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Notes on Practical Irrigation

D. H. Anderson

How Plant Food Is Transformed Into Plants.

The growth of plants from the seed to the harvest, or fall of the leaf, may be divided into four periods, during each of which they live on different foods and expend their energies in the production of different substances.

This is important to be well understood, for plants can not be dieted like animals, they need certain provisions at certain periods of their growth, and if not supplied with them the result is failure, or a sparse crop. A farmer feeds his chickens egg-producing food, his cows milk-generating fodder and mash, and his cattle fat-making provender. He might as well deprive his animals of their necessary stimulating food and expect them to go on laying eggs, furnishing milk and growing fat, as to expect his crops to succeed without providing them with the requisite material to arrive at perfection. But, to proceed.

These four periods in the life of plants are:

First—The period of germination, that is, from the sprouting of the seed to the formation of the first perfect leaf and root.

Second—From the unfolding of the first true leaves to the flower.

Third—From the flower to the ripening of the fruit or seed.

Fourth—From the ripening of the fruit, or seed, to the fall of the leaf and the return of the following spring.

Of course, in annual plants, when the seed or fruit is ripe or harvested, there are no more duties or functions to perform, hence the plants die, having accomplished the object of their existence. But in the case of perennial plants, there are important things to be done in order to prepare them for the new growth of the ensuing spring.

Period of Germination.

1. To sprout at all, a seed must be placed in a sufficiently moist situation. No circulation can take place, no motion among the particles of the matter composing the seed, until it has been amply supplied with water. Indeed, food can not be conveyed through its growing organs unless a constant supply of fluid be furnished the infant plant and its first tender rootlets. This does not mean drenching the immature plant with water, but supplying it with moisture. A child needs feeding just as much as an adult, but not to the same extent, and overfeeding kills the young plant as quickly as the young animal. The reason is plain, if the reader remembers what was said in the last article, in which it was specified that water is a chemical compound of oxygen and hydrogen. In this state it is too strong a food for the young plant, and "drowns" it out, as the saying is. But in a state of moisture, the chemical nature of the water is altered somewhat and becomes available to the juices in the seed, whereby the germ is enabled to grow and fulfill its mission without meeting with a premature death. It is water that is the parent of moisture and without water, of course, there can be no moisture. Nevertheless, throughout this entire series of articles it is moisture that will be insisted upon; when plants have that, the whole object of irrigation will be accomplished, unless it be the intention to grow aquatic plants.

Now, this moisture must be constant during the entire life of the plant, not liberal one day with the next day dry, and so on, alternately, as some say may happen in the case of pork for the purpose of making alternate layers of fat and lean in the bacon, but not in the case of vegetation.

2. A certain degree of warmth is necessary to germination. This warmth varies with the seed, some seeds, those containing much starch, for instance, requiring more,

and slow germinating seeds less. What is needed is not too early a planting and protection against any inclemency of the weather from frost or cold rains, and not too late a planting in locations where there are no winter or spring frosts, to avoid too great a heat from the sun, which is as dangerous to tender plants as frost. "Warmth" is a sufficiently descriptive word to make the meaning clear.

3. Seeds refuse to germinate if entirely excluded from the air, even where there is plenty of moisture. Hence, in a damp soil, seeds will not show any signs of life for a long time, and yet when turned up near the surface within reach of the air, they speedily sprout. The starch in the grain intended to feed the germ will not dissolve in water, so it happens that the farmer, sometimes, in ditching or digging a well, throws up earth that has lain many feet below the surface for years, perhaps ages, the length of time makes no difference, from which sprout plants of unknown varieties. They have never lost their vitality. The "oat hills" in the southern part of California are familiar examples. Year after year a good crop of oats springs up without planting, cultivating the surface being sufficient to bring the buried grain within reach of the air. It is said that the old Padres originally sowed this grain broadcast wherever they went, taking a sack of it on their horses, and as they traveled along cast handfuls of it in the most favorable spots. This grain grew to maturity year after year, going back to the soil unharvested, there being nobody to gather it. The civil and criminal records of the southern California courts are full of lawsuits and murders growing out of struggles to obtain and retain possession of these "oat hills."

A friend for whose accuracy there is abundant evidence, cites a case that happened to him personally in a small valley in the semi-arid region. Wanting water he began sinking a well and went down one hundred feet before reaching moist ground. That ground was a soft black loam, and desiring to keep it for a top dressing, he laid it aside for future use. Not long afterward seeds began sprouting all over it and, helping the sprouts with a little water to keep the soil moist, he raised a thick crop of fine sweet clover. The seeds had never been planted by the hand of man, for the formation of the soil indicaetd that it might have been in the same condition since the Deluge.

4. Generally speaking, light is injurious to germination, wherefore, the seeds must be covered with soil, and yet not so deep as to be beyond the reach of air. Sowing grain broadcast leaves much of it exposed to the light, and even after harrowing, it does not germinate, being food for birds and drying up or burning up in the sun. In light, porous soils, it is common, however, to sow broadcast and then plow under, afterward harrowing lightly. It is also common in the arid and semi-arid regions to plow the grain in "dry" in the summer or dry months, and when the rains come in the autumn, or say, in November and December, the grain sprouts in a few days.

The reason why light is prejudicial to germination and why atmospheric air is necessary is because during germination seeds absorb oxygen gas and give off carbonic acid, and they can not sprout unless oxygen gas is within their reach, the only place where they can obtain it being from the atmosphere. In the sunshine the leaves of plants give off oxygen gas and absorb carbonic acid, while in the dark the reverse takes place. Hence, if seeds are exposed to the sunlight, they give up oxygen which they need and absorb carbonic acid, which kills them.

5. During germination, acetic acid (vinegar) and diastase are produced, as mentioned in the last preceding article, whereby the insoluble starch is converted into sugar, which is soluble and can be absorbed as food by the youthful plant.

6. The tender young shoot which ascends from the seed consists of a mass of organs or vessels, which gradually increase in length, sometimes "unroll" into the first true leaves. The vessels of this first shoot do not consist of unmixed woody fiber, that is not formed until after the first leaves are fully developed. In the meantime the young root is making its way down into the soil, seeking a storehouse of nourishment upon which it can draw when the sugar of the seed shall all have been consumed.

These phenomena are brought about in the following manner: The seed absorbs oxygen and gives off carbonic acid. This transforms a portion of the starch into acetic acid, which aids the diastase to transform the insoluble starch into soluble sugar, or food that can be taken up into the plant. It also dissolves the lime in the soil contiguous to it, and returns into the plant, carrying the lime or other dissolved earthy substances with it. The seed imbibes moisture from the soil, and this dissolves the "sugary starch," so to speak, and it all goes into the circulation, and the plant is enabled to grow and develop its first leaves. It is like a baby fed on milk.

When the true leaves have expanded, woody fiber begins to make its appearance, which can be readily understood by attempting to break the plant stalk, a thing easily done before the first leaves appear, but not so easily afterward. The sugar in the sap is now converted into woody fiber, the root drawing up food from the soil, and the leaf drinking oxygen and carbonic acid from the atmosphere. The moisture must still be constant, for the root can not absorb food unless the latter is properly dissolved.

From the First Leaves to the Flower.

The plant now enters upon a new stage of existence, deriving its sustenance from the air and the soil. The roots descend and the stem shoots up, and while they consist essentially of the same chemical suostances as before, they are no longer formed at the expense of the starch in the seed, and the chemical changes of which they are the result are entirely different.

Here is where the farmer will make a fatal mistake if he relaxes his vigilance. The whole energy of the plant is directed toward one single goal, that of preparing for the flower which is the forerunner of the fruit. What the flower is, that will be the fruit.

The leaf absorbs carbonic acid in the sunshine and gives off oxygen in equal bulk, and the growth of the plant is intimately connected with this absorption of carbonic acid, because it is in the light of the sun that plants increase in size. Now, by this function of the leaf, carbon is added to the plant, but it is added in the presence of the water of the sap and is thus enabled by uniting with it to form any one of those numerous compounds which may be represented by carbon and water, and of which, as was shown in the last article, the solid parts of plants are principally made up. This period may be called the period of "plant building," the plant utilizing every material that will bring it up to the condition of flowering.

The sap flows upward from the roots, through which have been received the silica, potash, soda, phosphorous, etc., in solution, and reaching the leaves, meets the carbonic acid flowing in through myriads of mouths in the leaves, and then flows along back downward to the roots, depositing, as it descends, the starch, woody fiber, etc., which have been formed by the action of the carbonic acid. Thus the sap circulates round and round like the circulation of blood in the veins of an animal, except that its heart is not a central organ, but an attraction of affinities among the substances which enter into plant life, affinities constantly pursuing each other through the veins or capillaries of the plant, and forming unions, the products of which add to the growth of the plant and enable it to accomplish its destiny.

During this ante-flowering period there are produced in the plant not only woody fiber, but other compounds which play an important part in a subsequent stage of its existence; one of these, the most important, is oxalic acid, which has already been alluded to. This acid seems to be formed at this period to aid in perfecting the future fruits that will follow the flower. What is curious about these various acids now formed is that many of the plants are sour in the morning, tasteless during the middle of the day, and bitter in the evening. The reason is, during the day these plants have been accumulating oxygen from the atmosphere to form acids, but as the day advances this oxygen is given off, carbonic acid is imbibed and the acids decomposed. Hence the sourness disappears, but the materials are in the plant ready for use when required—the acid storehouse is filling against the day of need.

In the case of wheat, barley and other grains, the chief energy of the plant, previous to flowering, is expended in the production of the woody fiber of its stem or

stalk, and growing branches, drawing up from the soil for that purpose the various ingredients they require from among the inorganic elements, which unite with the vegetable acids in the sap and form compounds which are essential to the perfection of the grain or seed. In the first stage of its growth the starch of the seed is transformed into gum, and then sugar; in its second stage, when the leaves are expanded, the starch is transformed into woody fiber.

From the Flower to the Ripening of the Fruit.

The sap has now become sweet and milky, indicating sugar and starch. These during the third period are gradually transformed in the sap into starch, a process exactly the reverse, or contrary of that in the first and second periods. The opening of the flower from the swollen bud is the first step taken by the plant to produce the seed by which its species is to be perpetuated. At this period a new series of chemical changes commences in the plant.

1. The flower leaves absorb oxygen and emit carbonic acid all the time, both by day and by night.
2. They also emit pure nitrogen gas.
3. The juices of the plant cease to be sweet, even in the maple, sugar cane, and beet; the sugar becomes less abundant when the plant has begun to blossom. A change not difficult to understand when it is considered that nature is at work preparing to perfect the seed or fruit, and is not working for commercial interests. The structure of the plant is now of no consequence, and ceases to be of any importance. The imbibing of oxygen, which is the parent of all acids, is intended to convert the sugar into material for the seed, or fruit, the wheat or the peach, the strawberry or the squash.

The husk of grain bearing grasses, corn, wheat, oats, etc., is filled at first with a milky fluid which becomes gradually sweeter and more dense, or thicker, and finally consolidates into a mixture of starch and gluten, such as may be extracted from the grain as has already been said.

The fleshy envelopes of many plants, at first, tasteless, become sour and finally sweet, except in the lime, lemon and tamarind, in which the acid remains sensible to the taste when the seed has become perfectly ripe.

Fruits, when green, act upon the air like green leaves and twigs, that is, they imbibe oxygen and give off carbonic acid, but as they approach maturity they also absorb or retain oxygen gas. The same absorption of oxygen takes place when unripe fruits are plucked and left to ripen in the air, as is common in the case of tomatoes, oranges, lemons, and bananas. After a time, however, they begin throwing off carbonic acid and then they ferment, spoil or rot.

In the case of pulpy fruits, such as the grape, lemon, orange, apple, peach, plum, etc., when unripe and tasteless, they consist of the same substances as the leaf, a woody fiber filled with tasteless sap, and tinged with the green coloring matter of the plant. For a time, the young fruit performs the functions of the leaf, that is, it absorbs carbonic acid and gives off oxygen, thus extracting from the atmosphere a portion of the food by which its growth is promoted and its size is gradually increased. Remember what has been heretofore said about carbon constituting the bulk of the plant.

By and by, however, the fruit becomes sour to the taste, and this sourness rapidly increases, while at the same time it gives less oxygen than before, the retaining of the oxygen being, as has been said, the cause of the sourness, the oxygen converting the sugar into tartaric acid and water. The grape is an illustration, though the same thing happens in fruits abounding in the other vegetable acids.

This formation of acid proceeds for a certain time, the fruit becoming sourer and sourer. Then the sharp sourness begins to diminish, sugar is formed, and the fruit ripens. The acid, however, rarely disappears entirely, even in the sweetest fruits, until they begin to decay.

During the ripening of the fruit, the woody or cellular fiber gradually diminishes and is converted into sugar. This will be noticed in several kinds of fruits, particularly winter pears, which are uneatable when actually ripened on the tree, but become ripe, long after plucking, by continuing to absorb oxygen, which converts the woody fiber, or cellular tissue, into sugar, which is not difficult to understand, as woody fiber is very similar to sugar in its chemical constitution.

It should be noted that the entire forces of the plant are concentrated upon the seed, the element, or agent of reproduction, the pulp of the most delicious fruit, the kernel of the sweetest nut being nothing but protective envelopes and food supplies for the germ when the time and opportunity shall arive for germination. So that the object of the plant in making so many transformations is not fruit, but seed.

From the Fall of the Leaf to the Following Spring.

When the seed is fully ripe the functions of annual plants are ended. There is no longer any necessity for absorbing and decomposing carbonic acid; the leaves, therefore, begin to take in only oxygen, with the result that they are burned up, so to speak, and they become yellow, or parti-colored; the roots decline to take in any more food from the soil, and the whole plant prepares for its death and its burial in the soil by becoming resolved into the organic and inorganic elements from which it sprang, and of which it was originally compounded.

But of trees and perennial plants, a further labor is required. The ripened seed having been disposed of, there are incipient young buds to be provided for, buds which are to shoot out from the stem and branches on the ensuing spring. These buds are so many young plants for which a store of food must be laid away in the inner bark of the tree, or in the wood of the shrub itself.

The sap continues to flow rapidly until the leaves wither and fall, and then the food of the plant is converted partly into wood fiber and partly into starch. It has been shown how these substances are converted into food by chemical changes, or transformations, and these changes do not cease so long as the sap continues to move. Even in the depth of winter the sap slowly and secretly stores up starchy matter, in readiness, like the starch in the seed, to furnish food to the young buds when they shall awaken in the spring from their winter sleep. It is the same process as in the case of a seed planted in the ground.

Rapidity of Growth.

It has been shown that from carbonic acid and water the plant can extract all the elements of which its most bulky parts consist, and can build them up in numerous ways. But the rapidity with which the plant can perform this building up is almost incredible.

Wheat will shoot up several inches in three days, barley six inches in that time, and a vine twig will grow about two feet in three days. Cucumbers have been known to attain a length of twenty-four inches in six days, and a bamboo has increased its height nine feet in less than thirty days.

The rapid growth of vegetation in semi-tropical arid and semi-arid regions is phenomenal. A young eucalyptus tree has been known to grow thirty feet in a single season, and wheat or barley three inches high three days after planting is not uncommon. Potatoes (solanum tuberosum) have run up to fifteen pounds in weight before the plant had time to blossom, in fact, it never did blossom.

Three-pound onions, eighty-pound watermelons and five-hundred-pound squash are not rarities, and I have been told of a field of corn, of the white Mexican variety, that grew fourteen feet with four perfect ears of corn to the stalk with only twelve inches of rain. As for sweet potatoes, or yams, thirty pounds weight do not occasion surprise, and beets after two years' growth are often as large as nail kegs, all woody fiber, of course, and unfit for food.

It is true that such examples are mere experiments, indeed they may be called specimens of "freak" vegetation, and rarely mean perfection of quality, but they indicate the ability of the plant to rapidly assimilate from the soil and air large, even excessive, quantities of the elements it needs, or fancies, provided they exist in abundance, and they demonstrate that the farmer has it within his power to covert this enormous productive energy into "quality" of product by regulating it through adequacy of moisture and cultivation without excess.

In the foregoing articles nothing but the mere out-

(Continued on page 725.)

Second United States Land and Irrigation Exposition

The United States Land and Irrigation Exposition closed its second annual show at the Coliseum in Chicago on the evening of December 4th. This show, while not as well attended as that of 1909, was fully equal to it in point of exhibits, and owing to the fact that smaller spaces were occupied by the various exhibitors a much more attractive appearance resulted.

The various states and territories throughout the entire west and southern country prepared exhibits which would be a credit to any show or exposition.

It is hoped that some arrangement such as has been suggested by exhibitors, may be completed whereby the show may pass into the hands of the various newspapers in Chicago, who can organize and thereby take from it that condition which is objectionable to many of the exhibitors, viz.: the absolute control by one publication. The general impression seems to be that better publicity for the show and a larger attendance could readily be

New Mexico, "The New State."

obtained if all of the leading daily newspapers and trade publications of the city were active in its management.

We are giving herewith a detailed list of the exhibitors, as found by our representatives, and present also illustrations of several exhibits.

M. Rumely Company, La Porte, Ind., exhibited one of their 60 horse power oil traction engines. This machine differs from others as they use coal oil instead of gasoline. Mr. J. W. Rumely was in charge of the exhibit, assisted by John Woolf, L. W. Ellis, Leo Racher, J. W. Jay, O. H. Day, W. M. Robbins, all of La Porte, Ind.

* * *

The Kansas City Southern Railway Co. (Port Arthur Route) made a display of fruits and vegetables. This road traverses a rich farming section, where lands can be bought at a very low figure. Mr. F. E. Roessler, industrial and immigration agent, was in charge, assisted by J. Hollister Tull, agriculturist, Siloam, Ark., Ed. Wolf, Siloam, Ark., and H. A. Graber, general agent, Marquette building, Chicago. For further information write Mr. F. E. Roesler, Kansas City, Mo.

* * *

The Bitter Root Valley Land and Irrigation Co. was one of the largest exhibitors. They had a carload of apples on exhibition, consisting principally of McIntosh Reds and nineteen other varieties. W. D. Chase, Rockford; F. A. Schlick, Rockford, and W. J. Potter, Missoula, Mont., were also in attendance. F. A. Schlick, Rockford, was in charge of the exhibit, assisted by Prof. E. P. Sandsten, J. B. Ransom, Chicago; J. Y. Bryan, Peoria; Wm. Findlay, Peoria; R. F. Thompson, Racine, Wis.; E. W. Herbst, Chicago; C. N. Smith, Chicago, and E. Thorson, Stevensville, Mont. A large party left for the valley December 6th.

* * *

The St. Louis & Southwestern Railroad (Cotton Belt Route), in charge of Mr. Guy L. Stewart, Agricultural and Industrial Agent, 1328 Pierce Building, St. Loius, Mo., in charge, assisted by Mr. L. E. Saupe, Pierce Building, St. Louis, Mo., showing agricultural products from Southeastern Missouri, Arkansas, Eastern Texas and Northwestern Louisiana.

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Western Michigan Development Bureau, in charge of Mr. John D. Gibson, Secretary, Traverse City, Mich, exhibited cranberries said to be larger and better than the Cape Cod variety, also grains, fruits and vegetables. A. R. Wagner, representing the Hart brand canned goods presented to visitors samples of preserved strawberries and green peas. G. L. Hinkley, 201 Railway Exchange Building, Chicago, representing "Peaceful Valley Farms"; C. B. Buck, Traverse City; Ford P. Robbins, Boyne Falls, and W. H. Steele, Northport, Mich., assisted in boosting their respective counties.

* * *

St. Helen Development Co., St. Helen, Mich., in charge of Mr. John Carter, St. Helen, Mich. This company develops fruit farms for settlers on the easy payment plan. If interested in Michigan fruit farms address either Mr. H. E. Buck or F. G. Clark, Room 606, Strauss Building, corner Clark and Madison streets, Chicago.

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Northeastern Michigan Development Bureau was in charge of Cophaus Buttles, Lewiston, Mich., and T. F. Marston, Secretary, Bay City, Mich., showing everything the soil will produce.

* * *

Alabama, Sumatra and Havana Tobacco Co. T. P. Hamm, Jr., 1303 Heyworth Building, Chicago, in charge, illustrated the development of the tobacco industry in Baldwin county, Alabama. Tobacco growing is a science. The company furnishes experienced men to teach the new settler how to grow tobacco, because it is to their interest, as they buy all the tobacco for their own factories. The profits usually run from $800 to $1,000 per acre. A. E. Marks, Danville, Ill.; E. A. Hutchins, Battleboro, Ala.; L. Glendenning, Summerdale, Ala.; D. C. Sims, representing Mobile Progressive Association, Mobile, Ala., assisted in demonstrating the possibilities of their respective counties.

* * *

Rogue River Valley Commercial Club, Medford, Oregon. This booth was in charge of J. A. Perry, Medford, Ore.,

View Showing the Austin-Western Company and Irrigation Age Booths at the Land Show.

showing fifteen varieties of apples and pears. The fruit was grown in the famous orchard, consisting of 506 acres, which was bought by Mr. Speck for $500,000.

Henion & Hubbell, Chicago, representing the Deming Co. of Salem, Ohio, and the Morris Machine Co. of Baldwinsville, N. Y., displayed pumping machinery in operation. Anyone contemplating the installation of an irrigating plant or pumping plant of any kind should write them, giving conditions under which the pumps would have to work. Mr. R. C. Wise was in charge of exhibit.

* * *

Stark Bro's. Nurseries and Orchards Co., Louisiana, Mo., in charge of Mr. Wm. H. Stark, treasurer, assisted by John Hickerson, A. B. Howell and Miss Smith, all of Louisiana, Mo., demonstrating the superiority of fruit trees, especially of "Stark Delicious" apples grown and propagated by Stark Bros. Send for the "Stark Year Book," beautifully illustrated with colored plates. It is mailed free.

* * *

Florida Everglade Reclaimed Land Co., Mr. Chas. S. Holland in charge, 1215 First National Bank Building, Chicago, assisted by Mr. W. L. Butterworth, showing pineapples, oranges, grape fruit, vegetables, etc. The exhibit was one of the best in the show.

* * *

Prescott & Northwestern Railroad, in charge of A. M. Ellsworth, Secretary Prescott Commercial Club, Prescott, Ark., also Mr. J. C. Peary, Murfreesboro, Ark., showing Arkansas diamonds, also clays, stone, fruits, wool and farm products.

* * *

Commercial Club of Ellensburg, Wash., in charge of Secretary A. F. Shultz, W. F. Shellenberger and W. O. Palmer all of Ellensburg, showing Spitzenburg, Jonathan and Rome Beauties, for which that valley is noted, also seventeen other varieties, including Stark Delicious.

* * *

International Harvester Company, Chicago, in charge of L. E. Viers, Harvester Building, showing irrigating plant and delivery wagons. The exhibit was particularly interesting.

* * *

Missouri, Kansas & Texas Railway. Thos. Peeler, Industrial Agent, Dallas, Texas, in charge, showing various products along their line, especially mebane cotton, the use of which is recommended by the United States government experts for planting purposes in the South.

* * *

The Union-Southern Pacific Railroads and affiliated lines. The Oregon and Washington booth was in charge of Mr. J. H. O'Neill and Mr. W. E. Benton, both of Portland, Oregon, displaying prize winning commercial apples in boxes, also an extremely interesting display of nuts, vegetables, etc. Wyoming, Colorado, Kansas and Nebraska displayed two of the largest steers ever grown, weighing respectively 3,776 pounds and 3,740 pounds. "Stuffed Nebraska Boy," the famous pig, weighing 1,350 pounds, was also in attendance. E. M. Cobb, Elgin, Ill., was in charge of exhibit, assisted by D. C. Campbell, Colfax, Ind. The decorations were installed by E. R. Kelley, Elgin, Ill.

Arizona and New Mexico. E. A. Macon, Traffic Freight Agent, Tucson, Ariz., in charge of exhibit, showing fifty-eight varieties of cactus for making candy; also peanuts, roses, alfalfa and a relief map of the Roosevelt dam on the Salt river. G. W. Cute, Phoenix, Ariz., President Chamber of Commerce, demonstrated the resources of Arizona, California, Mexico and Nevada. A prominent feature of this exhibit was an enormous illuminated globe showing the Union-Southern Pacific Steamship and Railroad System encircling the world. This exhibit was in charge of Mr. H. W. Smith, Colonization Agent, 968 Flood Building, San Francisco, Cal., assisted by F. C. Lathrop, Commercial Agent, Pasadena, Cal.; O. G. Chisholm, Traveling Passenger Agent, San Francisco; B. F. Wright, Agent, Delmonte, Cal.

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Texas. H. P. Attwater, Houston, Texas, in charge of booth, showing a section of grape vine fifty inches round, also varied exhibits from farm, garden and orchard

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Louisiana. This exhibit greeted the visitor with the sight of grape fruit, oranges, persimmons, peanuts and watermelons. A display of rice showed the various processes of manufacture. J. C. Gilpin, New Orleans, La., was in charge of exhibit.

* * *

Utah and Idaho. State Horticultural Inspector J. Ed. Taylor had charge of Utah section, and R. P. Holbrook, Salt Lake City, of the Idaho section. The display consisted principally of apples, honey, alfalfa, potatoes, and almonds. Major Fred Reed was chief dispenser of apples and honey.

* * *

Washington County, Idaho. Showing twenty varieties of apples, wheat, barley, oats, alfalfa, potatoes four to five pounds, etc. The booth was in charge of John D. Robertson, Weiser; C. H. Bohrer, Weiser; M. A. Nelson, Cambridge, and R. E. Wilson, Cambridge, Idaho.

* * *

Frisco and Chicago & Eastern Illinois Railroad. One of the most interesting features of this exhibit was an electric map and a model relief map of the Frisco lines showing main line and branches running from St. Louis to Brownsville, Texas. The line from New Orleans to Brownsville, Texas, runs thirty miles north of coast of the Gulf of Mexico, and was opened to traffic two years ago. The Jonathan Pierce ranch, consisting of 60,000 acres, is on their line; also John O'Connor ranch of 71,000 acres. Both of these properties have been cut up in small tracts of 40 to 80 acres, selling from $30 to $50 per acre. The rainfall through this territory is 40 inches per year. There are also several tracts under irrigation along their line. If interested write Mr. S. A. Hughes, Immigration Agent, Frisco Building, St. Louis, Mo., who was in charge of the exhibit, for "Hunting and Fishing on the Gulf Coast," "Gulf Coast Irrigation," "The Ozarks," "Oklahoma," "Texas," and "Rice in Arkansas."

Irrigation Age Exhibit at the United States Land and Irrigation Exposition.

Palm Beach Company of Florida. P. J. O'Connor, 1407 Republic Building, Chicago, in charge of the exhibit which consisted of oranges, cocoanuts, lemons, etc.

* * *

Southern Land Investment Company. 229 Railway Exchange Building, Chicago, displaying grape-fruit, pineapples, oranges and vegetables. The property is located near Fort Meyer, Fla., the terminus of the Atlantic Coast Line. Mr. Thomas Kimball was in charge of the exhibit.

* * *

Porter Land Company made a fine exhibit of the Eucalyptus tree and the beautiful cabinet woods into which it is manufactured. A model of a 10-acre citrous fruit orchard and its irrigation system was shown. The booth was in charge of J. A. Carpenter and J. E. Miller, 703 Marquette Building, Chicago.

* * *

Tulare County, California, had a display of pomegranates, citrous fruits, Egyptian corn, dates and pressed fruits. The exhibit was under the auspices of the board of trade of Vasalia, Cal. A. E. Miot, secretary, was in charge.

* * *

San Joaquin County, California. A unique exhibit. A stock of alfalfa and what it produces, cows, chickens, stock,

farm yard scenes, worked out with tiny models most realistically. Jas. J. Rhea, secretary, San Joaquin County Board, Stockton, Cal., was in charge.

* * *

Alameda County, California. Exhibited a varied assortment of fruits, nuts, olive oil, dried fruits and wines, which received the gold medal at the Paris exposition. Another unique feature was a collection of pears weighing from three to five pounds, picked from trees planted in 1791 by the Spaniards at the Mission San Jose. A bust of Luther Burbank was appropriately placed in this booth. This wonderful man has enriched the world with many creations such as Burbank potatoes, spineless cactus, white blackberry and many other plants. Much of the success was due to that great genius and gentleman, Mr. W. D. Nichols, Twelfth and Franklin streets, Oakland, Cal., who processed all the preserved fruits, flowers and vegetables which were in the show. Mr. Nichols will be pleased to hear from any one wishing information regarding the processing and shipping of fruits, flowers and vegetables. Mr. Wilbur Walker, secretary of the Merchants' Exchange, Oakland, Cal., another gentleman of the type of Mr. Nichols, was busy showing visitors through the exhibit and demonstrating the superiority of the climatic conditions of Alameda County. Mr. W. D. Spencer also assisted.

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Los Angeles County, California. Mr. C. L. Wilson, secretary, Chamber of Commerce, in charge. A climatic globe of the world demonstrated the superiority of the Los Angeles brand of weather. There was also shown a case containing thirty varieties of precious stones.

* * *

Fresno County, California. This county is noted for raisins, wines, figs, lemons, oranges, seedless grape-fruit, olive oil, and grapes of which they had a large supply on exhibition. Twelve thousand loaves of raisin bread were distributed during the show. Mr. J. P. Swift, Fresno, Cal., Assistant Secretary Chamber of Commerce, was in charge.

* * *

Rock Island Railroad. Tastefully arranged exhibits of the products along its lines were arranged about the booth. Professor W. E. Vaplon, Fort Collins, Colo., was in charge of the poultry department. G. L. Calvert, Goodland, Kan., in charge of Northwestern Kansas. L. A. Fitz, Manhattan, Kan., representing Sherman County. C. V. Ruzek, Fayetteville, Ark., in charge of Arkansas booth. J. M. Lefler, Ames, Iowa, representing Iowa State Agricultural College. T. M. Jeffords, Stillwater, Okla.; Prof. C. Evans, Austin, Tex.; Prof. Andrew Boss, St. Paul, Minn., representing their respective agricultural colleges.

* * *

Sacramento Valley Colonization Company. J. H. Meer, 1234 McCormick Building, Chicago, in charge, showing processed fruits, orange trees in bloom, apples, oranges and lemons.

* * *

Mississippi Valley, Mississippi. G. G. Brooks, Jonesboro, Ark., in charge, showing cotton, corn, rice, wheat, oats and barley.

* * *

Missouri Pacific Railroad. A model farm of from five to forty acres was shown, complete in every detail of house and barn. The best methods of crop rotation were demonstrated. The International & Great Northern and Iron Mountain Railroad, the homeseekers' line to Texas, had their exhibit in the same booth with the Missouri Pacific Railway. Mr. J. M. Anderson, Immigration Agent, 103 Missouri Pacific Building, St. Louis, Mo., will send, upon request, "The Homebuilder," "Opportunity," "Money in Sheep, Fruit and Poultry," and booklet "Oklahoma." They are free if you mention Irrigation Age.

* * *

Lower Rio Grande Valley of Texas. One end of this booth represented the end of a sugar-cane field. Lemon, orange and kumquat trees, in full fruit, decorated the booth, as well as truck and alfalfa. Mr. R. N. Magill, Brownsville, Tex., was in charge of booth. All products were the result of irrigation.

* * *

Louisiana Progressive League. W. W. Willington, president, and M. L. Alexander, Alexndria, La., were in charge, showing syrup that took first prize at the St. Louis World's Fair; also corn planted June 8th, standing 19 feet tall, yielding 85 bushels per acre.

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Columbia County, Florida. Showing grape-fruit, lemons, oranges and vegetables. Mr. Geo. H. J. Haas, McCormick Building, Chicago, in charge. Mr. W. T. Shinn, assistant.

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Hillsboro County, Florida. This exhibit was installed by the North Tampa Land Company, 540 Commercial National Bank Building, Chicago. Display of citrous fruits, including a cluster of ten grape-fruit. Mr. A. H. Chapman was in charge.

* * *

San Luis Valley, Colorado. Showing irrigated products, consisting of potatoes, wheat, alfalfa. This is one of the most fertile valleys in Colorado, the record for potatoes being 847 bushels per acre, which are sold in the East. Wheat, 69 bushels per acre. Sugar beets, 23 per cent test. W. G. Brandenburg (Englewood), Denver, Colo., and W. N. Martin, Alamosa, Colo., were in charge of exhibit.

* * *

Montezuma Valley, Colorado. In charge of W. G. Clucas, representing Bozman Brothers, Cortes, Colo. This valley is on the Wolf River and 1,000 feet above sea level. Irrigated land is sold for $50 per acre up. The exhibit consisted principally of apples, pears and alfalfa.

* * *

Montrose County, Colorado. This exhibit was installed by Mr. C. H. Picker, Olathe, Colo., showing apples, potatoes, grains, vegetables and alfalfa. This county is made famous by the Gunnison Tunnel, which irrigates 150,000 acres of the finest land in Colorado. J. K. Johnston, Montrose, Colo., and F. F. Frazier assisted in demonstrating the superiority of their county.

* * *

Yakima Valley Commercial Club. H. P. James, secretary, North Yakima, in charge, showing 20 varieties of apples. This, like Walla Walla, is one of the most productive valleys in the world. Commercial orchards sell from $800 to $1,200 and have been sold as high as $6,000 per acre. One of the features was a box of Stark delicious apples, which took the first prize at the National Apple Show. A box of 1909 crop Winesap apples were also on exhibition.

* * *

Cheyenne and Lincoln Counties, Colorado. These are called dry farming counties, adapted principally to grains. The two counties were ably represented by J. P. Peterson, I. F. Jones, C. H. Norman, all of Cheyenne, Colo., and W. S. Pershing, Limon, Colo.

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Weld County, Colorado. J. F. McCrery, Greeley, Colo., in charge of exhibit showing irrigated products, consisting of potatoes, sugar beets, apples, grains for making starch and an exhibit of alfalfa.

* * *

Morgan County, Colorado. All products shown in this booth were the results of irrigation. Sixteen pounds perfect sugar beets. Red McCluer potatoes yielding 350 to 400 bushels per acre. W. H. Galloway, vice-president Vallory State Bank, Vallory, Colo., was in charge, assisted by H. W. Cooper, Vallory, Colo. Irrigated land sells from $75 to $125 per acre.

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Denver, Laramie & Northwestern Railroad. W. H. Olin, Industrial Commissioner, in charge of exhibit, showing grains and grasses under irrigation. H. Thomas, Laramie, Wyo., and J. L. Davis, sales manager, Denver, Colo., assisted in demonstrating the possibilities along the line of their road. Write Mr. W. H. Olin, Denver, Colo., for booklet entitled "What 10 Acres Will Do."

* * *

Brown-Walker-Simmons Company. A large relief map of the Panama Canal and its relation to San Francisco, geographically, was an interesting display. A map and plaster model of the Santa Maria oil fields was highly instructive and visitors were requested to write their names in the largest book in the world, 7 feet by 3 feet, when open. Mr. H. M. Britton, Crocker Building, San Francisco, was in charge of booth.

* * *

Post Falls Land & Water Co. Showing several varieties of apples. Mr. P. H. Dankin was in charge of exhibit. This

company is located in the Spokane Valley and is represented in Chicago by Jas. A. McLane & Co., 100 Washington street.

* * *

Grand Junction Area, Colorado. This exhibit was one of the best in the show. Among the many representatives were: Prof. E. P. Taylor, County Horticulturist; Thos. F. Mahoney, Secretary Chamber of Commerce; C. A. Lyman, official lecturer; R. E. Turpie, representing Grand Junction Fruit Growers' Association; Chas. A. Smith, President Grand Junction Poultry Association; N. A. Glasco, representing Grand Junction Orchards Home Association; C. G. Simpson, all of Grand Junction; Ed H. Randall and M. E. Nelson, both of Loma, Colo. All exhibits are the result of irrigation.

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Arkansas Valley of Colorado. Duncan & Raymond, 234 La Salle street, who make a specialty in developed orchards, had charge of exhibit.

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Texas Gulf Coast Citrons Union. Garrett A. Dobbin, Industrial and Colonization Agent of the Santa Fe, had charge of the booth, showing kumquats, oranges, preserves, etc.

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La Crosse Prairie Tract of Indiana. Showing corn, wheat, oats, onions, hemp, sugar beets and potatoes. S. S. Thorpe. First National Bank Building, Chicago, was in charge, assisted by Jens Laursen and Frank Thomas, Cadillac, Mich.

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Lewiston Land & Water Co. Showing 21 varieties irrigated apples, including winter banana, Stark Brothers' delicious winesaps and Rome beauties. Mr. R. S. Thain was in charge, assisted by F. M. Kauffman and E. N. Read, 1014 Corn Exchange Building.

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Baker Manufacturing Company, 526 Hunter Building, Chicago. Displayed the Twentieth Century Six-Purpose Irrigation Machine—grader, ditcher, leveler, brush grubber, border maker, grain cutter. The booth was in charge of Mr. Baker, personally.

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Wisconsin State Board of Immigration. Grain, grasses, fruits, woods, granites, iron and lead ores were exhibited. Mr. Geo. Gasling, 108 Washington street, was in charge.

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Original Fruit Belt of Michigan. Displaying non-irrigated apples, pears and grapes. Robt. Sherwood, Waterliet; W. C. Wiltey, Paw Paw; Robt. C. Smythe, Benton Harbor; C. E. Bassett, Fenville; C. J. Monroe, South Haven; representing the counties of Berrien, Van Buren and Allegan, respectively.

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Arkansas Exhibit. The "grass widow" of Arkansas was the life-size figure of a woman, hobble-skirted according to the latest mode. A grape vine, 12 inches in diameter, was another interesting feature. Rice in all stages was shown. The peach belt country displayed not only processed fruit, but truck and grasses. The diamond exhibit was marvelous. Arkansas is said to have the only diamond mines in the United States. The following had charge of their respective booths: C. Phil Waters, 115 La Salle street, Chicago; Schlenker Land Company, 912 Schiller Building, Chicago; Irvin Lyman, Booneville, Ark.; Ed Wilkin, Hazen, Ark., and H. H. Edwards, 139 Adams street, Chicago.

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Austin-Western Company. Exhibiting the Little Western Grader and Ditcher—an extremely interesting display. A. H. Hofeld and F. L. Jerome, 315 Dearborn street, Chicago, had charge of the booth.

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Kansas City, Mexico & Orient Railway. This was an educational exhibit from the lower Pecos Valley in Texas, where a new irrigation district is being opened by turning the waters of the famous Pecos River onto 25,000 acres of rich sandy loam. This new district is called Pecos Palisades. A relief map, showing the Palisades territory, was a feature of the exhibit—in fact a feature of the Land Show, as fully 10,000 persons viewed the model daily. The irrigation system comprises a reservoir covering 2,000 acres of land seventeen feet deep. There are 64 miles of canals. The irrigation plant is finished and cost over $300,000. The Pecos Valley is noted for its alfalfa and fruit products. Already, on older land under irrigation, seven tons of alfala have been harvested in one season, grapes pay $500 an acre and pears upward of $1,200 an acre. Pears grown in the vicinity of this new project won prizes at the St. Louis World's Fair. The purpose of the Orient land department at the Land Show was to conduct an educational campaign for intending settlers along the new K. C., M. & O. Ry. This line now has 960 miles of its 1,600 miles in operation. The Orient exhibit was in charge of W. R. Draper of Kansas City, assistant land commissioner.

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New Mexico Exhibit. This exhibit was gotten together and sent to Chicago by the New Mexico Bureau of Immigration, consequently was representative of the different interests of the entire territory. No one section of the great soon-to-be state tried to show everything that it could produce, but rather sent the products that would fit in best to make a comprehensive exhibit of the resources of the territory, as a whole. There were eight different sections of the territory represented, including Colfax county, Portales, Roswell, Carlsbad, Mesilla Valley, Deming, Las Vegas and Albuquerque. The Secretary of the Bureau of Immigration, Mr. H. B. Hening, deserves great credit for the showing made. The exhibit was the most comprehensive shown in the Coliseum. It ranged from coal and minerals through the entire list of grains and vegetables. The apple exhibit was exceptionally fine, demonstrating that New Mexico is full of opportunity in the fruit line. A pump, throwing 1,200 gallons of water per minute, emphasized that the lost rivers of the desert may be brought to the surface to make productive the fertile soil. At the present time Portales and Deming are reclaiming the desert by means of this system. A unique feature in connection with the New Mexico exhibit was the coat of arms of the territory, made of various colored beans, by Mrs. S. B. Colby, of Las Vegas. Another interesting feature of this exhibit was the automatic stereopticon, which revealed the new state as the camera sees it. A series of 500 pictures was shown, which were fully explained by people familiar with the territory.

The different sections were represented by the following persons: Las Vegas, Geo. Fleming, secretary of the Commercial Club, and Mrs. S. B. Colby; Portales, Mr. Ben Smith and E. P. Aldridge; Raton, Colfax County, C. O. Fisher, secretary of the Commercial Club, and J. S. Johnson; Roswell, J. S. Kirby, Mr. Jolly; Carlsbad, Mr. Hartshorn; Mesilla Valley, Prof. Fabian Garcia, of the Horticultural and Agricultural College; Deming, Ralph Ely, president Chamber of Commerce; Albuquerque, A. B. Stroup.

* * *

Great Northern Railway. The agricultural and horticultural products of Minnesota, Montana, Washington and Oregon were displayed under the supervision of this railway to excellent advantage in a space 110 feet long by 11 feet deep. The large red apple from Washington, of which there were about 6,000 on display, attracted much attention, also the processed fruits and vegetables, of which there were a couple of hundred jars. Wheat, oats, alfalfa, barley, clover and other grain and grasses were gathered from western fairs in many cases, where they took prizes and the prize ribbons were left attached. The entire exhibit was artistically decorated and presented and attractive appearance. Stereopticon lectures were held several times daily in the lecture rooms, where western farms and orchard scenes and other views were shown. A large quantity of literature pertaining to Montana, Washington and Oregon was distributed, and a registration kept of callers. The exhibit was installed and maintained under the personal supervision of Mr. E. C. Leedy, General Immigration Agent of the Great Northern road.

CHANGE OF ADDRESS.

The office of Mr. George G. Anderson, a well known Irrigation engineer of Denver, has been moved from 18 Hughes Block and is now located at 1232 and 1233 First National Bank Bldg., Denver, Col. Mr. Anderson is recognized throughout the United States, Canada and Mexico as authority on irrigation work.

IMPROVED WINTER EMMER.

Prof. B. C. Buffum,
Worland, Wyo.

About a dozen years ago there was introduced into this country a new grain which became known as Russian spelt. It was a spring grain and belonged to the emmers rather than to the spelts and it proved to be of much value in certain sections, more especially in the northern dry farming region of the central West and in the irrigated parts of the mountain states. At a later date a small quantity of the Black Winter Emmer was secured by the United States Department of Agriculture and sent out to some of the government experiment stations. This grain promised to be superior to the spring spelt because

Improved Winter Emmer. Edge of 10-acre field, 1910.

it would yield more per acre and there is much advantage to the farmer if he can plant his grain in the fall and harvest it in the early summer. But little of the seed was obtained and as yet this grain is little known. Professor Carleton, the cerealist of the department, estimated that winter emmer would yield twice as large crops as are secured from the so-called spring spelt.

On the experiment station farm at Laramie, Wyo., we raised seventy-two bushels per acre of the spring spelt and in our feeding trials the grain proved superior to corn for fattening lambs. It has given results better than corn at the Dakota station when fed to cattle on grass and was only a little less fattening than corn when fed to cattle in connection with the native hay, or for the production of baby beef. It has given results equal to or better than oats with horses in practical feeding trials.

In 1907 Professor Carleton sent me a small amount of black winter emmer which I planted at Worland and applied breeding methods with the hope that it might be improved and adapted. The first season we secured a hybrid between the winter emmer and a sporting winter wheat which has given rise to a most remarkable series of both old and new types of grain. There is promise of establishing one or more new species from these hybrids, but it will take a series of years to select and test out new grains of value from them.

By throwing the winter emmer under unusual conditions of soil and treatment its appearance, constitution and habit was so disturbed that we secured several mutations, or sports, and these have given rise to such change and improvement that those acquainted with the original emmer would hardly recognize the new product. It is larger, darker in color, heavier in straw and head, with larger stooling power and is much more hardy and prolific under our conditions than the original type. Many of the heads double the spikelets, giving the appearance of a composite wheat. We have grown single heads which weighed a half ounce. So prolific is the grain that in three seasons we succeeded in increasing it from the first sporting plants to more than seven hundred and ten bushels, threshing machine measure. This seed has all been planted in order to get as much grain as possible next season for distribution.

The New Improved Winter Emmer seems to be almost as hardy as winter rye and is one of our most drouth and cold resistant winter grains. Having been originated in the West, it is adapted to our conditions and it promises to be the most valuable feed grain the farmer or stockman can raise, whether he grows crops by irrigation or by dry farming methods.

The first season we grew improved winter emmer at Worland, the winter was very dry, there being no snow or moisture until the middle of March. Last winter was the coldest and most severe ever known in this region and so far as we could observe not a plant of the emmer winterkilled. Our last crop gave a remarkable yield under the conditions. It was grown on land which had been salt sage soil and which had produced two previous crops of barley and spelt, having had field peas planted with the grain the second year, but the peas made no crop. The emmer was seeded at the rate of thirty to thirty-four pounds seed per acre to make as much increase as possible. A part of the field was irrigated three times and a part only received two irrigations this season. The average yield as the grain came from the thresher was 69.1 bushels per acre. There were parts of the field which undoubtedly yielded twice this average. Many who visited the farm while the grain was ripening pronounced it the most beautiful grain field they had ever seen.

This grain is an important addition to our western farm products. Definite statements can not be made regarding its yields when planted and cared for properly on good soil, but it is safe to say that it will yield more grain and more feeding value per acre than can be secured from any other grain the farmer can grow. It should take the place of corn for stock feeding in the western country where the cool nights or the short seasons interfere with obtaining large yields of corn. It produces well where the summers are so hot that the weather interferes with the growth of spring grains. Being both drouth resistant and a winter grain, it will produce with a small

Improved Winter Emmer. Single stools standing in field, 1910—Worland, Wyoming.

amount of irrigation or rainfall. It has held its improved character for three years in the Big Horn Basin, so there is nothing but confidence in its success. This improved emmer should revolutionize our stock feeding and our sheepmen or other stockmen will not need to ship corn from the middle states.

Improved Winter Emmer. Head at right is the ordinary winter Emmer. This new form comes from a mutation or sport. The three heads on left side of picture show the change that has occurred. A portion of the heads throw out additional spikelets like a composite wheat.

Emmer is an early form of wheat. There are two large, plump kernals in each spikelet and the grain remains in the hull when threshed. The spikelets are large and closely arranged in the head. The head has no central stem or rachis and the spikelets merely break apart. If it is threshed when very dry and brittle with a high speed cylinder and all the concaves some of the kernels will shell out of the hulls. When separated from the hulls the grain will weigh a little heavier than wheat, but in the hull it weighs about the same per bushel as oats.

We call forty pounds a bushel, though no standard has been fixed.

The cracked emmer makes one of the most delicious breakfast foods for the table. Those who have tried it think it much finer than cracked wheat. It is splendid for poultry or swine and with the hull on it is a most excellent feed for cattle, sheep or horses. The hulls seem to be a great advantage to the grain for feeding. They insure thorough chewing and complete digestion, widen the ration so it is more nearly balanced when feeding with alfalfa and prevent any trouble from overfeeding as occurs with corn or wheat. It should not be necessary to grind emmer for horses or for sheep feeding.

Improved Winter Emmer. Bundle at left and two stools at right crop of 1910.

In most of the mountain region the winter emmer should be planted in September or early October, using about one bushel, or forty pounds of seed per acre. The grain will be ready to harvest early in July.

IRRIGATION ENGINEER PROMOTED.

Mr. C. R. Crownover, of North Yakima, Washington, has been promoted to the position of Project Engineer in the U. S. Reclamation Service and placed in charge of the Tieton Unit of the Yakima irrigation project, Washington, to take the place of Mr. Conway, who is leaving the Service to engage in private work. Mr. Crownover was appointed Engineer in the Reclamation Service in January, 1910, having been previously engaged as Superintendent of Construction. He will be located at Naches, Washington.

SALT RIVER VALLEY REPORT.

An interesting report of the operations of the Reclamation Service in Salt River Valley for the crop year of 1910 has been made by the engineer in charge.

During the past year the Service maintained and furnished water through 490 miles of canals for 131,364 acres, the largest area ever watered in the valley. The water supply was ample throughout the year, although this has been a season of unusual drouth and low water. The lands in crop received more than five acre-feet of water, or sufficient to cover each acre 5 feet deep. The maintenance and operation of the vast system of canals in the Salt River Valley is a more complicated and difficult problem than it would be in the northern country, owing to the fact that the irrigation season is twelve months. Repairs and enlargements must be carried on in connection with irrigation, for there can be no shut-down of the works.

In the valley, crops are growing all the time. There the harvesting and planting occur every month in the year. An enormous amount of work was required to put the irrigation system in its present condition. All the old canals which were absorbed by the Government were in need of repairs; most of them were too small and had to be enlarged and many new canals were constructed. Today everything is working perfectly and is probably supplying a larger area than any single irrigation system in the United States. Agricultural experts declare it is without doubt the most fertile and productive agricultural district in the United States.

The most important single factor in the valley's great development this year was an assurance of an abundant supply of water. The guarantee was provided by the enormous reservoir created by the Roosevelt dam. During all the low water months when the Salt river is ordinarily dry, the big lake was pouring forth a generous stream of water which was picked up by the canals and turned upon the thirsty land. In such a year as the present one, Salt river without storage would have proven inadequate, and there would have been a shortage of crops on all farms and a greatly reduced acreage in cultivation.

The most important crop, and the most valuable was alfalfa. Probably 65,000 acres were harvested. More than 5,000 acres were in canteloupes and melons.

DANGER TO ALL INTERESTS WHEN FARMERS ARE POOR.

The American farmer never has received fair compensation for raising grain or producing milk, and it is only in the last five years that he has been decently paid for his meat production. Trained business men would not give their time and investment on any such terms as the farm does. If middlemen—buyers, packers, merchants or carriers—are responsible for price inflation they are the ones who should be brought to account.

In this new campaign for lower prices let us make sure that we are aiming at those who are to blame for the extortionate rates which have prevailed for the last few years. A cheapening of farm products will not help business conditions. It is quite possible that cheaper food will lessen the burden of city life for the poor, but not if it be at the expense of wages and business activity.

The low price of corn today is something of a blow to farmers, who are not purchasing goods freely nor circulating money with as great liberality as they would if they were getting higher rates for their produce. When the producers begin to hold up their food supplies on account of depressed markets, business becomes slack in the country, money circulates slowly, storekeepers are unable to sell goods or pay bills, and bankers report bad times. This at once affects city wholesalers and manufacturers, who employ less help and cut wages. Times soon become bad all over under such conditions.

This is not a theory but a fact which has been painfully demonstrated in the last few weeks of money stringency. Fortunately for producers the low prices for country supplies have prevailed only a short time and the purchasing power of farming communities is not yet greatly crippled.

Irrigation of Orchards

BY SAMUEL FORTIER

Chief of Irrigation Investigations, Office of Experiment Stations, U. S. Department of Agriculture

Evaporation Losses from Orchard Soils.

A light shower followed by warm sunshine may refresh the foliage of fruit trees, but its effect on the soil is more likely to be injurious than otherwise. A brief, pelting rain followed by sunshine forms a crust on the surface of most soils, and if this is not soon broken up by cultivation it checks the free circulation of air in the soil and also tends to increase the amount of water evaporated.

It has been found (a) that the amount of moisture held by the soil, the temperature of both soil and air, and the rate of wind motion are the chief factors in the evaporation of water from soils. The influence of moisture is shown in the following figures, obtained from tank experiments made at Tulare, Cal., in 1904:

Evaporation from Tulare soils which received different amounts of water, June 15 to September 15, 1904.

Number of tanks.	Amount of water applied, inches.	Loss by evaporation. Inches.	Per cent.
1 and 2	0.0	0.45	.....
3 and 4	3.3	3.5	106.0
5 and 6	4.9	4.6	94.0
7 and 8	6.6	5.5	83.6
9 and 10	8.2	6.6	80.0
11 and 12	9.8	7.9	79.5

The results of other experiments have shown that when the water is applied to the surface of orchard soils the loss by evaporation is very great so long as the top layer remains moist. Even in light irrigations this loss in forty-eight hours after the water is put on may amount to from 10 to 20 per cent of the volume applied. In order to reduce this loss and moisten the soil around the roots of trees, the practice of running small streams of water in deep furrows has become quite common. In applying water in this way the top soil remains at least partially dry, the bulk of the water soon passes beyond the first foot, and the surface can be cultivated soon after the water is turned off.

The well known effect of temperature on evaporation is shown in figure 26. The dotted line shows the mean monthly temperatures at Tulare, Cal., from January 1, 1904, to December 31, 1905, and the solid line the monthly evaporation from a water surface for the same time.

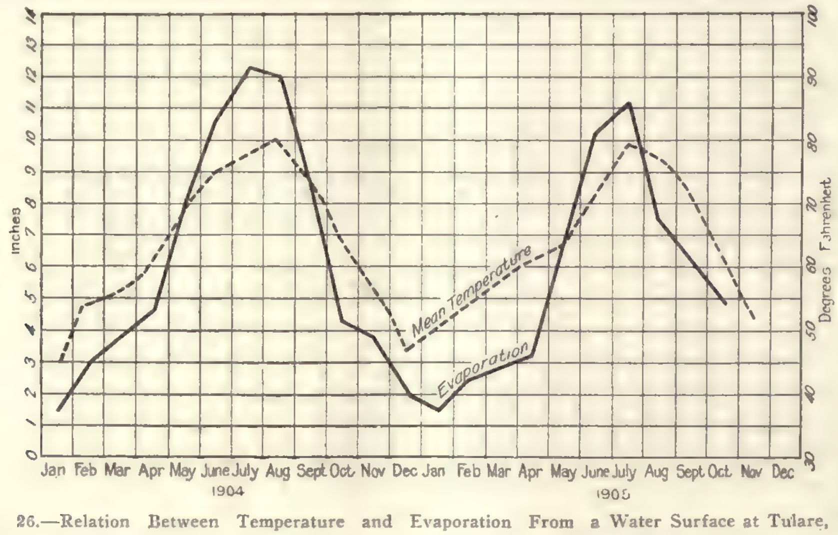


Fig. 26.—Relation Between Temperature and Evaporation From a Water Surface at Tulare, Cal.

Effect of Soil Mulches in Checking Evaporation.

The effect on evaporation of a layer of dry granular soil when placed above moist soil has been shown by a series of experiments conducted in tanks by irrigation investigations of this office. These tanks are water-jacketed and placed in the open under normal conditions as regards sunshine, wind and temperature. Each tank holds about three-fourths of a ton of soil and is weighed at stated intervals in a manner shown in figure 27. The results of experiments made at Davis, Cal., in 1908 are given in the following table:

Evaporation from soils protected by different depths of soil mulch at Davis, Cal., September 1 to October 3, 1908.*

	No mulch, tanks 1 and 2.		3-inch mulch, tanks 3 and 4.		6-inch mulch, tanks 5 and 6.		9-inch mulch, tanks 7 and 8.	
Average weight of tanks, September 1, pounds	1,104.7		1,090.0		1,082.0		1,085.2	
	Per ct.	Per ct.	Per ct.	Per ct.	Per ct.	Per ct.	Per ct.	Per ct.
Average loss, 3 days, September 1 to 4	16.75	17.83	1.75	1.86	0.0	0.0	0.0	0.0
Average loss, 4 days, September 4 to 8	4.5	4.79	.75	.80	.25	.27	— .5	— .53
Average loss, 3 days, September 8 to 11	3.0	3.19	2.25	2.4	.75	.80	— .25	— .27
Average loss, 4 days, September 11 to 15	1.5	1.60	2.5	2.66	....	....	....	....
Average loss, 18 days, September 15 to October 3	8.0	8.52	7.0	7.45	4.75	5.05	2.25	2.4
Total loss, 32 days, September 1 to October 3	33.25	35.93	14.25	15.17	5.75	6.12	.75	.80

*U. S. Dept. Agr., Yearbook, 1908, p. 468.

The soil first received an irrigation of 6 inches in depth over the surface and in the tanks which had no mulch; over one-third of this amount was evaporated in thirty-two days, while less than 1 per cent was evaporated in the tanks which were protected by a 9-inch mulch.

Similar experiments carried on at Wenatchee, Wash., in June, 1908, showed the following losses in twenty-one days: No mulch, 14⅓ per cent of water applied; 3-inch mulch, 4 per cent; 6-inch mulch, 2 per cent; and 9-inch mulch, 1 per cent.

From the foregoing it is evident that western orchardists can prevent the greater part of the evaporation losses by cultivating orchards to a depth of at least 6 inches as soon as practicable after each irrigation.

Loss of Water Due to Percolation.

In the preceding paragraphs attention has been called to the large amount of water which is vaporized from warm, moist soils. The above heading calls attention to another loss of a different character. In all modes of wetting the soil, but more particularly when deep furrows are used to distribute the water, a part is liable to sink beyond the deepest roots. As a rule, the longer the furrow the greater is the loss from this cause. In furrows

about one-eighth of a mile long Doctor Loughridge found in his experiments at Riverside, Cal., that in some parts of the orchard the soil was wet as a result of a recent irrigation to depths of 20 to 26 feet, while in other parts the moisture had not penetrated beyond the third foot.

One of the best ways of finding out whether much water is lost by deep percolation is to dig cross trenches as deep as the feeding roots go. The moisture which passes the deepest roots in its downward course may be considered wasted.

An example of fairly even and desirable moisture distribution from furrows is shown in Sections XI and XII of figure 28, where the three curved lines show the margins of the wetted soil at the end of one, two, and three days, respectively.

Removal of Waste Water.

The loss of water is not the only effect of deep percolation. The water which escapes in this and other ways usually moves through the soil at a rather slow rate of speed until it reaches some underground body of water at a lower level. In case orchards have been planted at lower levels when the subsoil was dry, care should be exercised in observing the rise of the ground water level. The small post-hole auger shown in figure 29 is one of the most convenient tools to use in making test wells to keep track of the behavior of the ground water. Before the deepest roots of the fruit trees are submerged, artificial drainage ought to be provided. Otherwise the ground water will at first lessen the yield and finally destroy the trees.

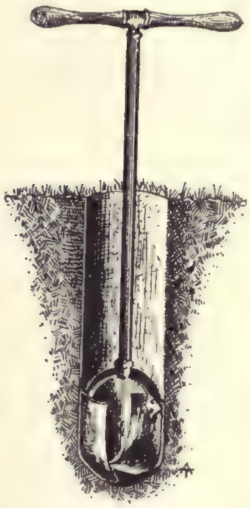


Fig. 29.—Soil Auger Used to Locate Ground Water Level.

The drainage of orchard tracts usually progresses in more or less distinct and separate stages. When the ground water begins to be a menace, the natural ravines in the vicinity are cleared of weeds and other rubbish and deepened. If the ground water continues to rise, the open drains are deepened and extended or else the excess water is withdrawn through covered drains. Open drains in orchards occupy valuable land, obstruct field work, and are expensive to maintain. Some of these objections can be lessened if not removed by locating such drains along the lower boundary of the tract. When this plan is followed, covered drains are frequently laid among the trees and discharge into the open drains. Sometimes the source and

Fig. 27.—Tank Experiments at Reno, Nev., to Determine Effects of Soil Mulches in Checking Evaporation.

direction of the waste water which is waterlogging an orchard can be traced beneath the surface. In this event it is well to try to intercept its passage before it reaches the trees. This can be done by an open drain, but a covered pipe drain of the required size is preferable. Where durable lumber is cheap, box drains similar to that the rate of interest low, but sooner or later the trees will

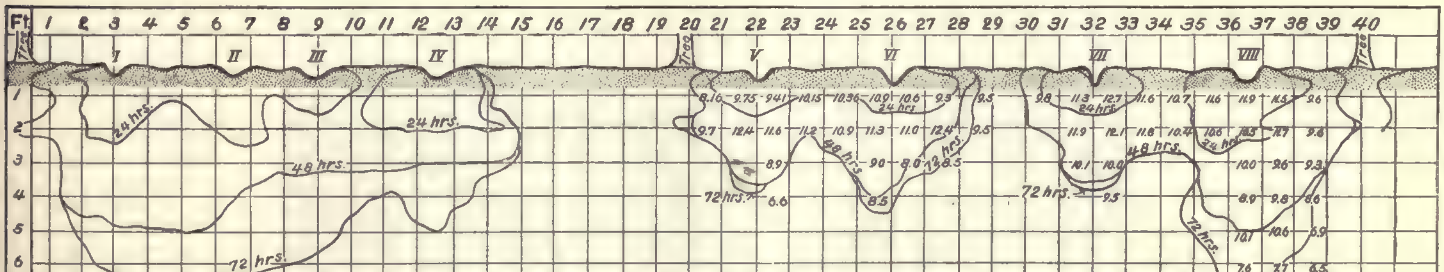


Fig. 28.—Outlines of percolation under sixteen furrows in orchard 58 under the Gage Canal Company, Riverside, Cal.

shown in figure 30 may be used. Where lumber is high in price, it will be more economical to use pipe drains made of either clay or cement. The former is most frequently used for sizes ranging from 4 to 8 inches in diameter and the latter for sizes 10 inches and over. The clay or tile drains are made 1 foot in length, but in using cement for the larger sizes the length may be increased to 2 and even 3 feet.

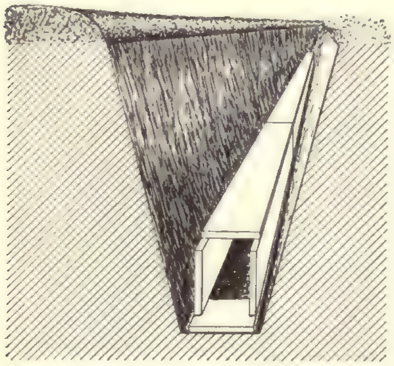


Fig. 30.—Box Drain.

The drainage of irrigated lands differs in many respects from that common to the humid states of Iowa, Illinois or Ohio. In irrigated districts the drains are larger and are laid deeper. While 4-inch tile drains may be used in places, 6-inch drains are to be preferred, and should be considered as the smallest desirable size. The depth at which they are laid ranges from 4 to 7 feet, and 5 to 6 feet are required for orchards. A grade of 5 feet to the mile is about the least that should be used, and wherever practicable it should be increased to 10 feet to the mile.

In laying drains that are likely to become clogged with silt or roots, or both, a small cable is laid in each line, and at distances of 300 to 500 feet sand boxes similar to figure 31 are placed so as to facilitate cleaning the tiles with suitable wire brushes.

Growing Crops Between the Tree Rows.

The large majority of California fruit growers do not grow marketable crops between the trees. They believe in clean culture, except where leguminous crops are used to renovate and fertilize the soil. From the standpoint of the large commercial orchard and the well-to-do proprietor, this practice has much to recommend it. The planting of such an orchard is regarded as a long time investment. Little, if any, returns are expected for the first few years, but when the trees approach maturity and are in full bearing the anticipated profits are supposed to compensate the owner for all the lean years. Any treatment, therefore, which tends to rob the soil of its plant food when the trees are young or to retard their growth is pretty certain to lessen the yields and the consequent profits in later years. Prof. E. J. Wickson, director of the California Experiment Station, tersely expressed the prevailing opinion on this question in California in his work, "Californa Fruits and How to Grow Them," in the following language: "All intercultures are a loan made by the trees to the orchardist. The term may be long and need restitution to the soil of the plant food removed by intercropping."

Fig. 32.—Orchard Showing Strawberries Between Rows of Trees.

Mr. S. W. McCulloch, who controls 150 acres of citrus orchards in southern California, goes further in stating: "It is always detrimental to the development of an orchard to grow crops between the trees. In some cases the effect is not marked aside from securing less rapid growth, but it will affect the crops of fruit for several years and in the end nothing will be gained."

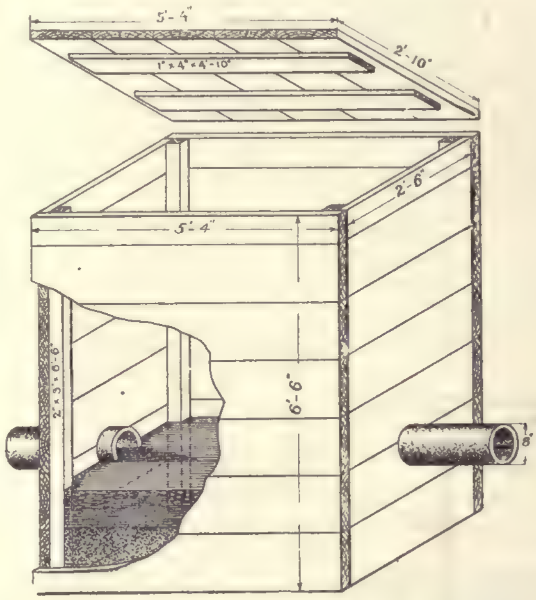


Fig. 31.—Sand Box in Tile Line.

Notwithstanding all this, the poor man must needs make the loan or his children may starve. The settler on a small tract set out to young trees can not afford, if his means are limited, to wait four or five years for the first returns. He must product crops between the rows, and the question for him to consider is how this can be done with the least possible injury to the trees. A plentiful supply of water and a deep rich soil are the essentials of intercropping. In districts that depend on a meager rainfall of 15 to 20 inches per annum, or where irrigation water is both scarce and costly, the practice becomes of doubtful value under any circumstances. In most of the fruit districts of the West water for irrigation is still reasonably low in price, and the extra amount required for intercropping represents but a small part of the net gains from such crops.

Shallow-rooted plants are considered the most desirable for this purpose. Squash, melons, sweet potatoes, tomatoes, and peanuts are the most common in Califor-

(Continued on page 712.)

Supreme Court Decisions

Irrigation Cases

DEFINITENESS OF DITCH LICENSE—

Though a license to construct a ditch on the licensor's land is indefinite as to location and extent, it becomes definite in such respects when located and constructed.—*Shaw* v. *Profitt.* Supreme Court of Oregon. 110 Pacific 1092.

NON-COMPLIANCE WITH STATUTES—

Actual appropriation of water without compliance with the Code gives to the appropriator a right as against any one who did not have at the time of his diversion a superior right, and, though it cannot devest prior rights, it is good as against a subsequent appropriator.—*Duckworth* v. *Watsonville Water & Light Co.* Supreme Court of California. 110 Pacific 927.

COMPLIANCE WITH STATUTES—

Compliance with the Code by an appropriator of water cuts off rights accruing between the date of the posting of notice of appropriation and the actual diversion for beneficial purposes; but, where no such rights have intervened, an actual appropriation may be made without following the Code. —*Duckworth* v. *Watsonville Water & Light Co.* Supreme Court of California. 110 Pacific 927.

UNNECESSARY PARTIES TO SUIT.—

A decree enjoining interference with plaintiff reservoir company's water in a canal of an irrigation company, with the irrigation company's head gates, and with its superintendent, was not objectionable, because the irrigation company was not a party to the suit. *Hackett* v. *Larimer & Weld Reservoir Co.* Supreme Court of Colorado. 109 Pacific 965.

WATER RIGHTS ON PUBLIC LANDS.—

When a water right and a ditch right connected therewith are acquired while the lands embracing the point of diversion and a portion of the ditch are public lands, those rights are not affected by the subsequent location, entry, and patenting of such lands. *Snyder* v. *Colorado Gold Dredging Co.* U. S. Circuit Court of Appeals. 181 Federal 62.

OBLIGATION TO COMPLETE IRRIGATION CANAL.—

An obligation to complete an irrigation canal and to furnish water for land in the future has the same effect on the question of a deed being a mortgage to secure performance as if it were an obligation to pay a debt in a fixed sum due at a specified future date. *Boyer* v. *Paine.* Supreme Court of Washington. 110 Pacific 682.

APPROPRIATION.—

Where the court found that appellee made two distinct appropriations of water for a reservoir, the first on March 5, 1901, of 200 cubic feet per second, and the second on October 22d, of the same volume, a decree awarding appellee a priority of 400 cubic feet per second, as to March 5, 1901, was erroneous. *Windsor Reservoir & Canal Co.* v. *Lake Supply Ditch Co.* Supreme Court of Colorado. 98 Pacific 729.

PHOTOGRAPHS IN EVIDENCE.—

In an action for wrongful diversion of a water course to the injury of plaintiff's land, certain photographs of the premises showing the condition of the land after the diversion of the water after proof of correctness and the manner and time of taking were properly admitted as explanatory of the effect of the diversion of the water. *Rickett* v. *Atlantic Coast Line R. Co.* Supreme Court of North Carolina. 69 Southeastern 8.

JUDGMENT AFFECTING PERSONS NOT PARTIES TO SUIT.—

A decree fixing a consumer's right to use water from an irrigation company's canal in a suit to which a reservoir company was not a party is no defense to a suit by the reservoir company against him and others, to enjoin interference with the company's water in the irrigation company's canal; the reservoir company not being required to intervene in the first suit. *Hackett* v. *Larimer & Weld Reservoir Co.* Supreme Court of Colorado. 109 Pacific 965.

POLLUTION OF STREAM.—

Any use of a stream that materially fouls the water, or a deposit therein of any filth that so far affects water as to impair its value for ordinary purposes, or anything which renders the water offensive to taste or smell, or which is calculated to excite disgust in those using it for ordinary purposes, is a nuisance, which equity will enjoin at the suit of a riparian owner injured thereby. *Shoffner* v. *Sutherland.* Supreme Court of Appeals of Virginia. 68 Southeastern 996.

TAKING LAND FOR DITCHES.—

The right under Const. art. 1, Sec. 16, and Laws 1899, c. 131, to take land for irrigation ditches is not defeated because water might be obtained by pumping; and it is immaterial why condemner acquired the lands to be irrigated, or whether he intends to farm them or sell them in tracts, if the lands are to be irrigated to enhance their agricultural value. *State ex rel Galbraith* v. *Superior Court of Spokane County.* Supreme Court of Washington. 110 Pacific 429.

POINT AND MODE OF DIVERSION.—

So long as a riparian owner takes no more than his share of water from the stream and uses it on his land for irrigation without waste, it is immaterial to lower riparian owners at what point the water is diverted or by what means; whether at the point far above where the elevation of the stream will be sufficient to carry the water to the land by gravitation, or by a dam and headgate, or by pumps and buckets. *Turner* v. *James Canal Co.* Supreme Court of California. 99 Pacific 520.

RIGHTS OF THE UNITED STATES.—

The United States has constitutional authority to organize and maintain an irrigation project within a state where it owns arid lands, whereby it will associate with itself other owners of like lands for the purpose of reclaiming and improving them, and for that purpose may exercise the right of eminent domain against other land owners to obtain land necessary to carry the proposed project in effect. *Burley* v. *United States.* U. S. Circuit Court of Appeals. 179 Federal 1.

ENLARGING DITCH.—

An easement for a ditch used in diverting and carrying water covered by an existing appropriation does not carry with it any right to enlarge the ditch, or to change its location or to use it in diverting and carrying a largely increased volume of water under a later appropriation, but is limited to the maintenance and use of the ditch, substantially as then constructed, for the purpose of utilizing the existing appropriation. *Snyder* v. *Colorado Gold Dredging Co.* U. S. Circuit Court of Appeals. 181 Federal 62.

RIPARIAN RIGHTS.—

Where an owner of land conveyed his riparian and water rights and privileges belonging to the land, except necessary water for domestic uses, and subsequently conveyed the land to a third person, the latter was estopped from asserting any right in conflict with the right of the grantees of the riparian and water rights, and the fact that the third person based a claim to water on an appropriation made subsequent to the deed was immaterial. *Duckworth* v. *Watsonville Water & Light Co.* Supreme Court of California. 110 Pacific 927.

INTERFERENCE.—

Where the grantee of a right to use an irrigation ditch to convey water in excess of a stated amount required for the use of the grantors, caused a depletion of the waters in the ditch without providing for an additional supply to make up the deficiency, so that the grantors did not receive the amount to which they were entitled, the rights of one of the latter were involved to his injury, and he could sue for relief. *Carnes* v. *Dalton.* Supreme Court of Oregon. 110 Pacific 170.

RIGHTS OF APPROPRIATORS.—

Where, in a suit involving the right to the water of a lake, defendant alleged the diversion of 40 inches through a 15-inch pipe for the irrigation of lands and for an emergency supply, an amended pleading, alleged that it had connected the pipe with a reservoir connected with its system of pipes supplying a city for the purpose of appropriating the water for a reserve for emergency uses, did not show that it had a right to anything in excess of the 40 inches. *Duckworth* v. *Watsonville Water & Light Co.* Supreme Court of California. 110 Pacific 927.

APPROPRIATION.—

The fact that, of the several thousand acres of land which may be irrigated at an expense of $10 or $12 per acre under a proposed project, a thousand acres may be irrigated at $5 per acre because of its being at a lower level or nearer the water than the other land, does not

justify the territorial engineer, under Laws 1907, c. 49, regulating the use and distribution of waters, to refuse the owners of the other land the privilege of irrigating their land under a plan which will increase the cost of irrigation to the owners of the thousand acres. *Young & Norton* v. *Hinderlider*. Supreme Court of New Mexico. 110 Pacific 1045.

SEEPAGE WATER.—

Where seepage or spring water appeared on the land of H. in 1906 from some unknown source at a place where there had been no seepage or spring water for at least five years before, and thereafter continued to flow in various quantities until a portion was permitted to flow on the land of D., whom H. agreed might use the surplus water, it was not subject to appropriation and distribution as provided by Laws 1907, c. 49; any surplus remaining after the reasonable necessities of H. and D. had been satisfied being distributable under the general law of prior appropriation. *Vanderwork* (*Territory of New Mexico, Intervener*), v. *Hewes*. Supreme Court of New Mexico. 110 Pacific 567.

NOTICE OF APPROPRIATION.—

A notice of appropriation of water within a United States forest reservation, which states all the matters required by Civ. Code, Sec. 1415, relating to the notice of appropriation of water, and which states the points of diversion as located on a designated section and township which the court judicially knows is within a reservation, is sufficient within section 1422, providing that where the place of intended diversion is within a reservation, and is so shown in the notice of appropriation, the claimant shall have a specified time after the grant of authority to occupy and use the reservation for such intended purpose with which to commence the construction of the works, etc. *Wishon* v. *Globe Light & Power Co.* Supreme Court of California. 110 Pacific 290.

RIGHTS OF RIPARIAN OWNERS.—

An operator of a sawmill on a stream threw sawdust into the stream, so that the same was deposited in it and in springs near to it. The deposits discolored the water, and in warm weather the decaying sawdust gave it an offensive odor. Live stock in some instances refused to drink the water, and it was less fit for domestic purposes and was unwholesome. Physicians believed that the decaying sawdust deposits affected the purity of the water, and generally caused disease along the streams where found. *Held*, that the use of the stream was in violation of the rights of a lower riparian owner, who could sue to restrain such use. *Shoffner* v. *Sutherland*. Supreme Court of Appeals of Virginia. 68 Southeastern 996.

TERRITORIAL ENGINEER.—

Laws 1907, c. 49, Sec. 12, provides that the territorial engineer shall have supervision of the apportionment of the water of his territory according to licenses issued by him and his predecessors and the adjudications of the courts. *Held*, that under section 1 of the act, providing that all natural waters flowing in streams and water courses, whether perennial or torrential, within the territory, belong to the public and are subject to appropriation for beneficial use, the jurisdiction of the territorial engineer under section 12 only related to public unappropriated waters within the territory, and had no application to seepage or spring water arising on the land of a proprietor from an unknown source. *Vanderwork* (*Territory of New Mexico, Intervener*) v. *Hewes*. Supreme Court of New Mexico. 110 Pacific 567.

DENIAL OF PERMIT BY TERRITORIAL ENGINEER.—

Laws 1907, c. 49, regulating the use and disposition of waters, making all natural waters in streams public waters, and authorizing the territorial engineer to deny an application for a permit to appropriate waters, if in his opinion the approval will be contrary to the public interest, does not limit the power to reject an application to a case in which the proposed project would be a menace to the public health or safety, and the fact that the statute is designed to secure the greatest possible benefit from the waters for the public must be borne in mind in construing the statute, and, where there is available unappropriated water of a river for only a few thousand acres of land, it is contrary to the public interest that a project for irrigating a much larger territory without water shall receive the approval of the engineer. *Young & Norton* v. *Hinderlider*. Supreme Court of New Mexico. 110 Pacific 1045.

WRONGFUL TAKING OF WATER.

In a prosecution for the wrongful taking of water from an irrigating canal, the information in failing to allege ownership of the canal was fatally defective, the statute under which the suit was brought being analogous to those of theft and malicious mischief involving a trespass upon the property of others. *Dolan* v. *State*. Court of Criminal Appeals of Texas.

INTERFERENCE WITH CANAL.

It was no defense to a suit by plaintiff reservoir company, to enjoin interference with its water in the canal of the irrigation company, that defendants had the right to use water as against the irrigation company, nor that plaintiff was organized by that company's stockholders to carry water through the canal and knew of defendants' rights, nor that plaintiff's waters were commingled with those to which defendants were entitled, though the irrigation company neglected its duty to distribute the commingled waters. *Hackett* v. *Larimer & Weld Reservoir Co.* Supreme Court of Colorado. 109 Pacific 965.

PRIOR APROPRIATORS.

A river divided into two branches, K. and S., between which a natural channel opening into K. existed. An artificial channel was dug, connecting S. with the natural channel, and, by means thereof, the waters of S. were diverted to K. for use below the mouth of the natural channel. When the water was low in S. river at the point of diversion, it would not reach the point of an attempted diversion by another. *Held*, that the upper appropriator of the waters was a prior appropriator as against the one who attempted to divert the waters of S. *Evans Ditch Co.* v. *Lakeside Ditch Co.* Court of Appeal, Third District, California. 108 Pacific 1027.

DIVERSION OF ADDITIONAL WATER.

A riparian owner learned that a canal company intended to divert larger quantities of water of a stream than it had theretofore claimed. During the same month he filed a supplemental complaint in a suit to prevent the proposed increased diversion. On being stricken, he commenced a suit for that purpose. No appropriation of the waters had been made by the company prior to the commencement of the action. *Held*, that the riparian owner was not estopped from invoking the aid of equity to restrain the company from diverting additional water from the stream. *Miller & Lux* v. *Madera Canal & Irrigation Co.* Supreme Court of California. 99 Pacific 502.

DETERMINATION OF PRIORITIES.

The special proceeding outlined by Mills' Ann. St. § 2421, providing that no recognition of any priority of water rights shall be regarded by any water commissioner in distributing water until claimant by application to the proper court has obtained leave and made proof thereof and received his decree therefor, is not a proper one to sustain a claim of priority under section 2268 (Rev. St. 1908, § 3176), giving a priority to the owner of a meadow watered by the natural overflow of the stream whose supply is diminished by the construction of irrigation ditches by others, where such priority would relate back to an earlier date, and so injure the rights of others whose priorities had been adjudicated in a statutory proceeding. *Broad Run Inv. Co.* v. *Deuel & Snyder Improvement Co.* Supreme Court of Colorado. 108 Pacific 755.

APPROPRIATION OF WATER.

The purpose of Civ. Code, § 1422, fixing the time within which to commence excavations on public reservations for the purpose of making a diversion of the water of a stream, is to protect claimants unable to proceed with the work necessary to perfect their claims by reason of the fact that the place of intended diversion or a part of the route of intended conveyance is within a national reservation, pending the procurement, with due diligence, of the authority from the federal government, and the provision that the fact that the place of intended diversion is within a reservation shall be shown in the notice is inserted simply for the purpose of requiring the notice itself to furnish evidence of the fact and of holding the claimant to a specific point of diversion within a reservation. *Wishon* v. *Globe Light & Power Co.* Supreme Court of California. 110 Pacific 290.

DIVERSION OF OVERFLOW—

The fact that plaintiff's low land would be greatly benefited by its overflow from an abutting stream during flood season does not entitle him to restrain diversion of a reasonable amount of water for irrigation by upper riparian owners, though such diversion would diminish such overflow.—*Turner* v. *James Canal Co.* Supreme Court of California. 99 Pacific 520.

RECEIVER FOR IRRIGATION CORPORATION—

The court will not appoint a receiver of a public service irrigation corporation to supply the water needed to irrigate the lands of those who have purchased water rights where there has been no misappropriation of corporate funds, and where the owners of the lands have refused to pay further water rents on the ground that the damages, the failure of the corporation to comply with the contracts to furnish water exceeded the amount claimed for water rents, and where the only source of revenue of the corporation is the collection of water rents from the purchasers of water rights, and where it is not shown that a receiver has facilities for collecting those rents superior to those possessed by the corporation, or that sufficient funds for the operation of the irrigation plant can be collected by any one.—*Grandfalls Mut. Irr. Co.* v. *White.* Court of Civil Appeals of Texas. 131 Southwestern 233.

ACQUISITION BY USER.

Where when water was distributed to plaintiffs and defendants under a decree adjudicating the amounts to which they were entitled from a stream, defendants claimed and received water only on the basis of 1 cubic foot per second to each 50 acres claimed to be under cultivation, and plaintiffs received the remainder on the same basis, that defendants during certain years received more than they were entitled to under the decree, by falsely claiming to have more land under cultivation than they actually had, would not divest plaintiffs of their right to such additional amount wrongfully appropriated by defendants, nor would the fact that both parties used all the water they wished from the stream during high water establish a user by defendants of such additional amount so as to divest plaintiffs' rights thereto; plaintiffs not having intended to admit defendants' absolute right to more water than allowed them by the decree, and the water commissioner not having intended to allow them more than that amount. *Drach* v. *Isola.* Supreme Court of Colorado. 109 Pacific 748.

INJURIES FROM STORAGE OF WATER.

Mills' Ann. St. § 2272, makes the owners of reservoirs liable for all damages from leakage or overflow of the waters or by floods caused by breaking of the embankments. Laws 1899, c. 126, § 9, provides that none of its provisions shall relieve the owner of any such reservoir from the payment of damages caused by the breaking of the embankments thereof, but in the event of any such reservoirs overflowing, or the embankments, dams, or outlets breaking or washing out, the owners thereof shall be liable for all damages occasioned thereby." *Held,* that the owners of reservoirs are liable absolutely for all damages from leakage or overflow of the water, or by floods caused by the breaking of an embankment, and they are not relieved from such liability by the fact that they have omitted nothing that human skill and foresight could suggest in the construction and maintenance of the reservoir to render it absolutely safe, and their liability is the same, even if they have used a natural hillside as a part of the restraining wall and it washes out, as the words "embankment" and "dam" must be construed as including barriers. *Garnet Ditch & Reservoir Co.* v. *Sampson.* Supreme Court of Colorado. 110 Pacific 79.

RIGHT OF WAY FOR DITCH.

Act Cong. March 3, 1891, c. 561, §§ 18-21, 26 Stat. 1101, 1102 (U. S. Comp. St. 1901, pp. 1570, 1571), providing that one may have the right of way through the public lands for the use of a canal or ditch for irrigating purposes, where a map of the same is filed with the Secretary of the Interior for his approval within 12 months after the land has been surveyed by the government, is not inconsistent with Act Feb. 15, 1901, c. 372, 31 Stat. 790 (U. S. Comp. St. 1901, p. 1584), providing that one may run telegraph lines, water pipes, etc., over the public lands subject to use for parks and reservations on obtaining permission from the Secretary of the Interior so as to require such permission in case of a canal built for irrigation, since the former act applies to canals and ditches the main purpose of which is irrigation, and for whch an easement attaches which becomes permanent on the approval of the Secretary of the Interior after the land has been surveyed; while the latter act refers to the granting of a mere license revocable at any time of the right to construct canals, telephone, and telegraph lines, etc., over the public lands, which may be used for parks and reservations. *United States* v. *Lee.* Supreme Court of New Mexico. 110 Pacific 607.

CONDEMNATION OF WATER RIGHTS.

Code Civ. Proc. § 1238 prescribes the public uses in behalf of which the right of eminent domain may be exercised, and subdivision 12 authorizes the condemnation of property for canals, reservoirs, dams, ditches, flumes, aqueducts, and pipes, and outlets natural or otherwise for supplying, storing, and discharging water for the operation of machinery to generate and transmit electricity to supply mines, quarries, railroads, tramways, mills and factories with electric power, and to apply electricity to light or heat mines, quarries, mills, factories, incorporated cities and counties, villages or towns, and to furnish electricity for lighting, heating, or power purposes to individuals or corporations, together with lands, buildings, and all improvements in or upon which to erect, install, place, use or operate machinery to generate and transmit electricity for any of the uses set forth. Subdivision 13 authorizes condemnation for electric light, heat, and power lines. *Held,* that such subdivisions authorize a corporation organized to furnish electric light, heat, and power to condemn the water in a stream, and the riparian rights of landowners, for its necessary requirements, and that such company is not limited to the acquisition of water by appropriation. *Northern Light & Power Co.* v. *Stacher.* Court of Appeal, Third District, California. 109 Pacific 896.

ISSUANCE OF IRRIGATION BONDS.

B. & C. Comp. § 4714, as amended by Gen. Laws 1909, p. 364, provides that "for the purpose of procuring necessary property and rights therefor and otherwise carrying out the provisions of this act" the board of directors of any irrigation district shall formulate a plan and estimate the cost of carrying it out, and determine the mode of raising the necessary funds therefor, and after submitting the plans to the state engineer, and receiving his report, the board shall call a special election to determine whether bonds shall be authorized, and, if the bonds authorized are insufficient and said board deems it for the best interests of the district that additional bonds be issued, it may again submit the question to the electors, and, if additional bonds be not voted, it shall be the duty of the board to provide for the completion of the plans by levy of assessments. B. & C. Comp. § 4714, prior to amendment, provided that for the purpose of "carrying out the provisions of this act" the board of directors of any irrigation district, whenever the construction fund has been exhausted, may call a special election to determine whether bonds shall be issued. *Held,* that where the directors of an irrigation district have used the funds received from a sale of bonds issued under section 4714 prior to amendment, they are authorized by the amendment thereto to provide for the issuance of additional bonds. *Hall* v. *Hood River Irr. Dist.* Supreme Court of Oregon. 110 Pacific 405.

GOVERNMENT IRRIGATION PROJECT.

Irrigation Act June 17, 1902, c. 1093, § 1, 32 Stat. 388 (U. S. Comp. St. Supp. 1909, p. 596), provides for the formation of a reclamation fund with money received from the sale of public lands in certain states and territories. Section 3 authorizes the withdrawal from entry of lands required for irrigation works, and on the completion of surveys of such lands, etc., makes it the duty of the Secretary of the Interior to determine whether the project is practicable, and, if so, the public lands which they propose to irrigate shall only be subject to entry of specified tracts. Section 4 provides that, if there are necessary funds in the reclamation fund available for the purpose, the project shall be constructed on a contract with the Secretary, who shall give notice of the lands irrigable and of the charges to be made per acre on the entries to be made and on lands in private ownership which may be irrigated by the waters in the project. Section 5 declares that no right to the use of water for land of private ownership shall be sold exceeding 160 acres to any one landowner. *Held,* that the act contemplated the irrigation of private lands as well as lands belonging to the government, and that the fact that a scheme contemplated the irrigation of private as well as a large tract of government land did not render the project illegal, so as to prevent the condemnation of land necessary to carry it out. *Burley* v. *United States.* U. S. Circuit Court of Appeals. 179 Federal 1.

The Necessity of Spraying

BY

HOWARD EVARTS WEED

When we figure out the annual money value of any special agricultural crop, we obtain some surprising figures. If we then add 20 per cent to these figures as representing the annual loss through the work of the injurious insects and fungous diseases—the loss is really greater than this on the average—we get some idea of the great loss to agriculture caused by the work of insects and fungi. We then have our eyes opened to the necessity of such a "small" matter as fighting insects and fungous disease.

Generally speaking, spraying with various insecticides and fungicides is the best means of preventing loss by these enemies to agriculture. But there is no work on the farm where attention to detail is more necessary than in spraying operations. To accomplish results, the spraying must be applied at just the right time and with the right chemicals used in correct proportions. Otherwise our work is mostly useless, which is always discouraging, for we are all after results. After all, we make a success or failure of life largely in proportion to the attention we give to the small things of life—to the little details—and attention to detail in spraying is certainly no exception to the rule. But of more importance than anything else is spraying in time. There is practically no use in the application of a fungicide to a plant after we notice that plant disease is present. Fungicides are preventives and not remedies and their application must be made long before the indications of disease are present. But when we find disease present, we should prepare for the spraying so as to ward off the disease the following year. Then again with insects, we will have to keep a close watch for them and apply the remedy just as soon as we notice the insects upon the plants, for it only takes a few days for a lot of insects to destroy a crop.

But while every farmer should thoroughly understand the subject of practical entomology and mycology, it is not necessary that one should study these subjects from the scientific side. All we want to know is how to prevent loss, and in order to know this it is only necessary that we know a few general principles as to why we apply the fungicides at all, and why and how we use certain insecticides for certain insects. So in order to consider the subject properly, let us take two insects and one plant disease attacking the apple to serve as examples of the whole subject. We will thus consider the Apple Worm, the San Jose Scale and Apple Scab.

Apples are wormy because a small moth lays its eggs in June on the blossom end of the forming apples at about the time the blossoms fall. These tiny eggs hatch into small worms which eat into the fruit. In three or four weeks the worms have become full grown and come out of the apples and "pupate" or pass into a resting stage either upon the tree, in crevices or under pieces of bark. Then in another ten days they hatch into the moths, which lay the eggs for a second brood. The winter is passed mostly in the pupa state. Did you ever find the little cocoons of silk with the pupa within them along the sides of apple barrels early in the spring? Well, the coming spring look the barrels over and see that these cocoons are destroyed, for it will mean that many less moths to lay their eggs on your apples next summer. The fact is you had better stop reading this article and look over those apple barrels right now.

Now then for the remedy for wormy apples. If the apple trees are thoroughly sprayed just after the blossoms have fallen with Paris green or the arsenate of lead, just a little portion of the poison will be placed on the blossom end of the forming apples at about the time the eggs of the first brood are hatching, and the worms will be killed by eating of the poison. We thus see the importance of placing a little of the poison on each forming apple, for if the spraying was not thoroughly done it would just "happen" that we missed just the places where the young worms are hatching. In former years Paris green was used in spraying fruit trees, but now it is found that arsenate of lead is much better and we get better results in every way. So that Paris green is a back number now. I shall not stop to explain why, but would refer you to that last bulletin from your Experiment Station which told all about it. By the way, what did you do with that bulletin?

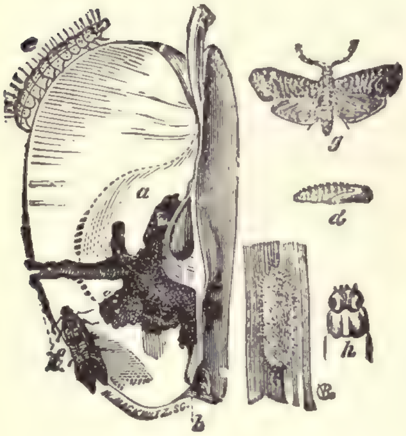


Fig. I.

Fig. II.

Fig. III.

The various stages of the Apple Worm are shown in Fig. 1. In this insect we have a case where the insect eats fruit or foliage and we kill such an insect with a substance which acts as a poison when eaten. In fighting insects we should know how food is taken, for then when we find an insect that eats foliage we can kill it by means of a poison applied to its food plant. This is a general principle which should be remembered.

Now let us take the well known San Jose scale, shown in Fig. 2, as an example of how insects should be killed which *suck* their food. In these insects the mouth parts are formed into a beak through which the plant juices are sucked. There has been so much said and writte nregarding the San Jose scale for ten years past that one would think that every farmer would know all about it by this time. Yet when we find an apple with some little red spots upon the skin

we think it a peculiarity of that variety, not knowing that these spots are caused by the insect of which we hear so much. But it is really surprising what a foothold this scale has upon fruit growing today. Thanks to the system of nursery inspection now carried out in each state, the scale is not being distributed now as in former years. The only trouble is that we did not have the nursery inspection until after the scale was well distributed. One great trouble in the control of the San Jose scale is the indifference shown by most farmers when they find they have the scale. *Put this under your hat. The San Jose scale will kill out an orchard within three years after it becomes well established, unless spraying is practical in a thorough manner.* Yet notwithstanding this fact, spraying as a rule is not practiced until some of the trees are dead. Very often it will pay to cut down and burn some few trees in order to save the rest.

As all scale insects suck their food it would be useless to destroy them by spraying with the arsenate of lead or other like poison. So in this case we must apply what has come to be known as a "contact" insecticide. Such an insecticide kills by either penetration as an irritant or by closing the breathing pores of the insects. In the case of the San Jose scale, the best contact insecticide seems to be the lime and sulphur solution applied late in winter just before the buds swell. As the insecticide only kills those insects which are actually touched or covered with the spray, it is readily seen how important it is to have the spraying thoroughly done. Even with the best work some few scales will escape and for this reason the spraying will have to be done each year. For with the San Jose scale we cannot hope to exterminate it, but we can keep it well in check.

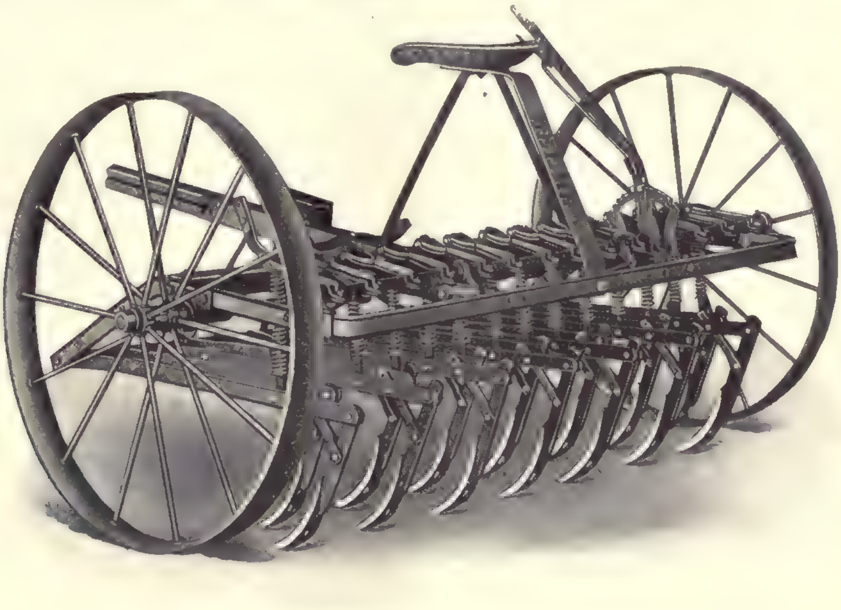
several times during the spring and early summer in order to thoroughly check the spread of the fungi. But as the copper sulphate alone would kill the foliage of the plants to which it is applied, we mix it with a solution of lime water and then we have the Bordeaux mixture.

So here we have three enemies of the same thing. Two insects and one plant disease. But in the case of the Apple Worm and the Apple Scab, experience has shown that we can combine the insecticide with the fungicide and make the application of the two in a single spray. Not only this, but there are many other insects and also plant diseases which attack the apple which are killed by the same spraying. As to what all these are, does not interest us half so much as simply to know that whatever they are, we get rid of them by the spraying.

But spraying is work, work, work. Does it pay? There is always a good demand at a good price for fruit of a superior quality, and superior fruit is of necessity sprayed fruit. What is the use of raising a crop of apple worms when by a little more work we can get a crop of good apples instead? The most success comes to the fruit grower who studies the When, Why and How.

LIKES AUSTRALIA'S PLAN.

Elwood Mead, for many years state engineer for Wyoming and afterwards chief of the Bureau of Irrigation at Washington, was called to the public service of the Australian state of Victoria three years ago. He tells his American friends that he believes in government ownership of railroads.



ALFALFA CULTIVATOR.

So much for the two general classes of insect extermination. Now what about plant diseases? It should be understood that plant diseases are caused by two different organizations—the *fungi* and the *bacteria*. The bacteria work within the plants and cannot be reached by any spraying. The best known example is the well known fire blight of pear and twig blight of apple. But most of the plant diseases are caused by fungi, the spores or eggs of which are produced on the exterior of the plants. The fungi are upon and within the plants early in the season, but if we apply some chemical such as copper sulphate to the plants we can prevent the germination of the spores and in this way we keep the plant disease in check.

Take the Apple Scab as an illustration of a plant disease. This is shown in Fig. 3. The fungi are upon the trees during the winter and in early spring send out the reproductive spores. So if we cover the branches in the spring with a fungicide such as the copper sulphate, we prevent the germination of the spores. Then as there is a new crop of spores every two, three or four weeks—depending on weather conditions—the spraying with the fungicides should be repeated

NEW BOOK ON ALFALFA.

The wide-spread interest now being taken in alfalfa with the consequent demand for reliable information concerning the best methods to pursue in order to secure good results, has impressed upon Deere & Mansur Company, of Moline, Illinois, the desirability of offering to the agriculturists of the country an authoritative treatise dealing with the seeding, culture and curing of alfalfa.

This company secured the services of A. M. Ten Eyck, Professor of Agronomy at the Kansas State Agricultural College, Manhattan, Kansas, and present the data which he has prepared in neat book form.

Deere & Mansur Company manufacture a line of tools especially adapted to the work of alfalfa growing, cultivating and harvesting. A brief description of them is given in the last pages of the booklet.

We are presenting in this connection a cut of one of their well known tools for working in the alfalfa to increase the crop.

A copy of this book will be sent free to all interested who will write and mention the IRRIGATION AGE.

INCIDENTS AND IDEAS OF THE CHICAGO LAND SHOW.

A land show if it draws at all brings together a host of men and women who believe in keeping their ideas brightened up. It can be said for the exhibition which has been held in Chicago recently that it was a success in spite of bad management. The exhibits from the newer sections of the country were excellent and varied. Everything tended to show that the agricultural class in the west is far ahead of that in the older localities. The modern idea of getting better results from the soil was manifest in many ways.

The irrigated farms of all the younger states gave of their abundance to illustrate what can be gained by intensive methods of agriculture. The fruit and grain exhibits were something to arouse pride. The methods of irrigation which were so comprehensively set forth were instructive to all. In this the machinery manufacturers divided honors with land owners.

The exhibits from Arizona were not a whit behind those of the other new states. Great interest was manifested by visitors in the famous Yuma district, where the Colorado river is an important factor. That stream is the Nile of the Yuma territory. Along the lower courses of the great stream has been formed a narrow strip of fertile soil in the midst of desert conditions and as the annual summer overflow is rich in fertilizing sediments it has kept up a sort of perpetual top dressing. The result is a body of land equal in fertility to that of Egypt, but of less extent, in a climate like Egypt's. Irrigation now takes the place of the summer overflow, but the fertilizing elements held in suspension by the stream are carried in the water of the canals and left upon the land. The problem indeed of the engineers has been to prevent the Colorado silt from choking the canals and covering the young crops as with a blanket, but this has been solved by "settling basins," while it is certain that enough remains in the irrigating waters to maintain the productiveness of the land unimpaired under the most severe cropping. Investigation by the University of Arizona demonstrated that four average acre feet of Colorado river water at Yuma carried sediment enough to make a layer of soil about one-quarter of an inch thick. On basing their computation upon the use of three acre feet of this water they found that the fertilizing value of this material, if bought in the market, would be about $9 per acre. Where such conditions prevail cultivation can never impoverish, but actually enriches the soil. "The knowledge," Professor R. H. Forbes of the University says, "is as old as human history, that river irrigating sediments increase the productiveness of the land," and they found 4.8 pounds of nitrogen in one acre foot of water from the Colorado, and 28.1 pounds from the Gila, which flows into the Colorado just below Yuma. So they found in Egypt long ago that the red Nile floods from Abyssinia were more valuable than those from other watersheds tributary to that river.

The Colorado Desert will be remembered by all who have gone into California by the Sunset Route of the Southern Pacific. One of the most desolate spots on the globe is the gateway to the bloom and the beauty of Southern California, yet perhaps the greatest single example of the triumph of irrigation in our day is seen in this forbidding desert.

Imperial Valley is the delta of the Colorado river in the extreme southeastern part of California and extending over the border into Mexico. Here, on both sides of the line are more than a million acres that probably once formed the bed of the ocean, an extension of what is now known as the Gulf of California. This has been filled up by the vast deposits of the yellow river, the head of the gulf being in the neighborhood of Yuma, sixty miles in an air-line from where it is now. It was a daring private enterprise which undertook to put water on this land, and would have been an ideal task for the Government itself. Engineers had long realized that water only was needed to convert this arid desert valley into a productive agricultural area, but it was not until January 1, 1902, that surveyors were on the ground mapping out a system of irrigation. One year later 2,000 settlers had arrived. By January 1, 1904, 70,000 acres were in cultivation; the settlers had increased to nearly 10,000, the railroad, the telegraph and telephone had come in; many homes were building, several towns starting, a national bank was doing business and stores were serving the new community. It reads like a tale from the Arabian Nights, but it is absolutely true. Irrigation does transform the desert. There are now in that wonderful valley 3,947 farms covering 731,520 assessed acres, and the total assessed valuation of the valley is $7,161,382. The value of the products produced this year exceeds $2,000,000, and its development has but just begun. It is wonderfully productive and, with its abundant water supply, yields crops the year round. The growing season never ends.

The first uses of the land are generally to grow barley. The land long unstirred responds more rapidly to higher priced crops after a year or two of cultivation. Alfalfa quickly follows barley, and the tremendous growth of this forage plant makes stock raising a prominent industry. Eight tons to the acre is called a low estimate for alfalfa, and this brings usually $10 per ton when shipped out of the valley.

Hogs are fed on barley and alfalfa and 3,000 have been kept on a single farm of 320 acres, the bulk of the acreage being in alfalfa. Where the latter grows all the year as here, cattle thrive, and the dairy is profitable. Many head of fine stock have been brought into the valley, and creameries have multiplied.

Figs, apples, dates, oranges and cotton raised in this valley were seen at the Chicago Land Show, together with a multiplicity of other agricultural products. Washington, Idaho, Montana, Oregon, Utah, Colorado and Wyoming had exhibits and supplied statistics which were no less interesting than those of California.

HITS CARELESS FARMERS.

Secretary Wilson declares that many farmers in the west are using too much water, being inclined to rely too much on water and not enough on cultivation. The difference between the good farmer and the poor is just as conspicuous in these regions as it is anywhere else.

COMPLIMENT TO A JUDGE.

It is a great compliment to Oregon that the judicial opinion handed down by Judge King, one of her supreme justices, is one of two decisions used by Judge Clayberg in his lectures on mining and irrigation law at the law school of the University of Michigan.

NEW PUMP CATALOG.

F. E. Myers Bro., of Ashland, Ohio, have issued a new Power Pump and Cylinder catalog No. P-11, which illustrates, describes and lists their new and improved line of goods. This catalog is well illustrated and will be sent free upon request.

WORK ON DIVERSION DAM COMMENCED.

The Ambursen Hydraulic Construction Company of Canada, Ltd., which is the Canadian company, affiliated with the home company in Boston, Mass., has commenced work on the diversion dam for the Canadian Pacific Railway on the Bow river, near Bassano, Alberta. The dam will be 51 feet high and 720 feet long, and is provided with a movable crest. There is no ledge rock of any character in that vicinity, and the dam, although it has to pass a flood of 100,000 second feet, will be built on a foundation consisting of from 3 feet to 5 feet of cemented boulder gravel, overlaying a bed of deposited clay, from 15 feet to twenty feet thick supported on sand of an unknown depth. Under these conditions the design of the dam is especially made with reference to prevention of underscour from the overfall.

AN EXCURSION INTO THE FIELD OF WESTERN FOSSILS

THE passenger department of the Union Pacific Railroad has revived great interest in the further exploration of the wonderful fossil fields of Wyoming, which are widely known in this country and whose peculiar value to scientists has long been established, by inviting a number of scientific men to visit that part of Wyoming and make personal investigation of the fields. These men went as guests of the Union Pacific Railroad and were escorted by an official of the company.

So many inquiries have constantly been received asking for full and detailed information regarding the discoveries that the passenger department of the Union Pacific Railroad has issued a booklet giving the impressions of some of the men of science who made this visit and describing in detail the geology of the Laramie plains and the topography of central Arizona.

Professor W. C. Knight of the University of Wyoming was in charge of the expedition.

Professor J. A. Yates, professor of natural sciences of the Ottawa University of Kansas, thus describes the expedition:

"Two days after arriving in Laramie, the expedition moved to the west, making a circle, the terminus of the trip to be the Grand Canon of the Platte river. We passed over excellent collecting grounds both in plant and invertebrate fossils, and on the eighth day of the trip we arrived at Aurora, the historic dinosaur field, where Professor Marsh of Yale, more than thirty years ago, discovered the bones of these immense lizards which are fully described in the sixteenth annual report of the Geological Survey.

"Here quite a number of specimens were found, and after remaining a day and two nights, we started for Freezeout Mountains, going by way of Medicine Bow, a small station on the Union Pacific Railroad. In these mountains the expedition was on virgin dinosaur fields and, so far as I know, every member of the party found and shipped some specimens of these bones. The writer, in connection with Prof. S. B. Brown of West Virginia University, found five vertebrae, two large femora and quite a number of large pieces of other bones of these animals. In this region we saw the bones that are being excavated by the American Museum people, also the Field Columbian, the Wyoming University and Kansas University Museums.

"The hundreds of square miles of these beds containing thousands of tons of the bones of these huge vertebrates, some of which are exposed by erosion each year, impresses one with the vastness of the burying ground over which we were traveling and the history of its formation and inhabitants while it was a low marshy plain. These bones are imbedded in a pale bluish-green stratum of clay varying in thickness from twenty to fifty feet. This stratum is easily found and recognized, being immediately above the shale overlying the Triassic red sandstones, under which is a layer where the belemnites are found very abundantly. Above the dinosaur stratum is a thick layer of sandstone, and boulders from this often tumble down dragging the bones among the talus, often making it difficult to determine the exact point from which the bones came.

"From our camp at Freezeout Mountains by three marches we arrived at the Grand Canon of the Platte. Here the Platte river has cut a channel with almost vertical sides a thousand feet deep, through the strata for a distance of nine miles. Owing to the arduous task of entering the canon, at many places this being impossible, the study of the exposed strata at close range becomes somewhat difficult. The writer, in company with Lieutenant Murphy of Wyoming University, entered the canon and drank from the rushing river. None of our company were daring enough to attempt to go through the canon, although we were told that only one man had ever succeeded who attempted it. On approaching the canon it was seen that we were on a rolling plain, indented here and there with small streams that had made rather deep channels for this country. However, I am sure it would never occur to a stranger that only two or three hundred yards in front of him was a chasm a thousand feet deep.

"Almost instantly you perceive there is a great canon in front where a moment ago you thought it was a perfect plain. Then you undertake to enter it through a ravine and travel many times the distance it was supposed to be, and of a sudden you find yourself standing on an immense strata of rock, a step more would land you six or seven hundred feet below in a stream, which rushes

Baptannodon Reedi Bones Found in a Quarry North of Union Pacific Railroad.

madly, as it were, past the boulders that have fallen from the cliffs. If one has imagined that he would like to go through the canon his slightest wish quickly leaves him on seeing the danger of such an undertaking.

"The most sublime sight I ever beheld was to stand on the edge of this canon and see the tilted strata, the Archean to the left and below, and look to the right and see the great number of strata through the series to the characteristic red beds of the Triassic and above these the Jurassic. The scene impresses one in a way that words meagerly describe, but the feeling comes that here is an epitome of Nature's records inviting one to read the history of these formations, see the principles of structural geology here unfolded, and conceive the great length of time necessary for their consummation.

"The noted Fremont fault is about three miles north of the canon. Here the carboniferous lime and sandstones are faulted and lying on the Jurassic, apparently, almost conformable. Here are five hot springs, the temperature of the largest being 140 degrees. The entire route through Wyoming afforded a most excellent opportunity for studying geology. The great amount of tilted and eroded strata, and the sparse vegetation, enabled one often to follow for miles, with greatest ease, a single formation, or to cross a great many different ones in traveling only a short distance."

As to the practical value of this expedition, Professor J. E. Todd of the Department of Geology and Mineralogy of the University of South Dakota, says:

"It enlarged greatly the stock of knowledge of every geologist enlisted, and of that sort best calculated to improve his teaching capacity. It substituted clear typical object lessons for the meager illustrations and halting descriptions of text books. Even those familiar with typical examples in the eastern part of our country were greatly impressed with the great advantage of the absence of vegetation and clearness of atmosphere in Wyoming.

"Views were more comprehensive and details more distinctly exhibited. This was true particularly of folds, faults, wind work and stream work, stratification and concretions. It afforded opportunities for excellent acquaintance with most interesting formations and fossils not accessible in the east.

"The erosion forms, the work of untold ages on the granite axis of the continent; the carboniferous rocks without coal; the glowing red beds; the Jurassic, with the various horizons, including probably the oldest great fresh water lakes, with their huge dinosaurs; the stretches of Cretaceous with its sandstone ridges and mesas, its gumbo plains and slopes, its chalk cliffs, glaring across the waste, its swarms of fossil shells, its gigantic globular concretions, its coal beds with fossil palms and deciduous trees; the Tertiary lake beds, with their monstrous mammalian bones, remnants of Nature's efforts in preparing the various beasts of the present time; the gravel-spread and boulder-dotted terraces of the Pleistocene age, records of the former floods which worked so faithfully to humble the pride of the rising Rockies, and convey their grandeur to beautify and enrich the plains of the Mississippi—all these are now vivid realities in the minds of all who rode over them and worked about them with this expedition.

"It will furnish substantial contributions to science. It is not yet time to sum up results in this line. Months and perhaps years may pass before we know what new species have been found, what conclusions are reached by many minds brought face to face with that wonderful region. It was not an unknown region. Many bright minds had already traversed it. Yet some new discoveries may be, at least, hinted. Numerous deciduous leaves were found mixed with abundant marine forms in the Fox Hills beds.

"A considerable fauna of fresh water invertebrates was found in the dinosaur beds of the Jurassic. This will no doubt be fully presented by those more closely identified with the discovery. The opinion that the Fox Hills' group is but a sandy local development of the Fort Pierre will be strengthened by the work of the expedition, and furthermore it may appear that the Laramie is but a local fresh water stage of the same.

"Several additional new features have been revealed in the dinosaur bones unearthed by this expedition. It has and will promote popular interest in science and education. This is not only by the public press and the pictures and fossils scattered by the members of the expedition throughout the country, but by the individual articles and lectures and by the proposed illustrated history.

"It calls fresh attention to the conclusions of geology concerning the building of the earth and the development of the life-forms. It reveals to many a new world of the imagination. Science has swept into oblivion the whole brood of mythological monsters, centaurs, griffons, chimeras and dragons, that once delighted the lovers of the terrible and strange, but now it is substituting the monsters of geological lore. It arouses new interest in 'The fairy tales of science and the long result of time.'

"It will stimulate a more healthy interest in science for its own sake. Let us hope that this expedition may arouse such lasting interest in scientists and the patrons of public museums in the wonders of the West that it may be but the first of a long series of similar vacation excursions which may prove of mutual advantage to all engaging in them and to the public at large."

(Continued from page 704.)

nia. The cultivation is done with one horse and a small cultivator. A clear space 3 to 4 feet wide is left on each side of the young trees. In the Verde River Valley of Arizona, strawberries, lettuce, onions and melons are raised in the young orchards. In parts of Idaho, alfalfa fields are frequently plowed under to plant trees. When this is done, berries, beans, melons, onions, and tomatoes can be grown between the rows for several years without any apparent injury to young trees. In northern Colorado, raspberries, gooseberries, currants, as well as corn, beans and peas are often planted in orchards, while in southwestern Kansas it is usually cabbage, melons and sweet potatoes.

In the young apple orchards of Hood River Valley, Oregon, strawberries are frequently planted between the rows. The maner in which this is done, as well as the system of contour planting which is there practiced, is shown in figure 32. The manager of a large apple orchard company in Montana states that no appreciable effect is noticed on apple trees as a result of growing potatoes, cabbage, beans, onions, and other vegetables between the trees, providing the intercrops are well cultivated and irrigated. In the fruit districts of Washington, intercropping is a common practice. In 1907 a fruit grower raised on 10 acres of two-year-old trees cantaloupes, tomatoes, peppers, cucumbers, corn, radishes, beans, peas, potatoes, and turnips, all of which netted him $2,086.50, or an average of $208.65 an acre.

While opinions differ regarding the wisdom of growing such crops as have been named between the tree rows, most fruit growers are convinced of the beneficial effects of cover crops. Notwithstanding the scarcity and high value of water in the Riverside citrus district, the superintendent of a large fruit company has for years grown peas and vetch in the orange and lemon orchards under his management, and advocates the free use of irrigation water to supplement the winter rains for the rapid and vigorous growth of such crops. In the walnut groves of Orange County, Cal., bur clover is sown in the fall, given one or two irrigations during the winter if the rainfall is below the normal, and plowed under in April.

The cost of such cover crops as peas, vetch, or clover includes the seed, the labor of sowing it, the water, and the time required to apply it. These items, according to Dr. S. S. Twombly, of Fullerton, Cal., amount to from $2.50 to $3.25 per acre. Twenty tons per acre of green material is perhaps an average crop. In this tonnage there would be about 160 pounds of nitrogen, which at 20 cents per pound represents a value of $32 per acre for a cover crop like vetch.

Other beneficial effects of cover crops are quite fully summarized by Prof. W. S. Thornber, horticulturist of the Washington Agricultural Experiment Station.

Winter Irrigation of Orchards.

When water is used outside of the regular irrigation period or, what is in many cases equivalent, outside of the growing season, it is termed winter irrigation. Over a large part of the arid region the growing season is limited by low temperatures to 150 days, or less, and when the flow of streams is utilized only during this period much valuable water runs to waste.

It was for the purpose of utilizing some of this waste that the orchardists of the Pacific coast states and Arizona began the practice of winter irrigation. The precipitation usually occurs in winter in the form of rain, and large quantities of creek water are then available. This water is spread over the orchards in January, February, and March, when deciduous trees are dormant. The most favorable conditions for this practice are a mild winter climate; a deep, retentive soil which will hold the greater part of the water applied; deep-rooted trees; and a soil moist from frequent rains.

The creek water which was applied to some of the prune orchards of the Santa Clara Valley, California, during the winter of 1904 was measured by the agents of this office with the following results: From February 27 to April 23, 1,241 acres were irrigated under the Statler ditch to an average depth of 1.58 feet. From February 12 to April 23, 2,021 acres were irrigated under the Sorosis and Calkins ditches to an average depth of 1.75 feet. In the majority of cases the orchards which are irrigated in winter in this valley receive no additional supply of moisture other than about 16 inches of rain water.

In the colder parts of the arid region winter irrigation is likewise being practiced with satisfactory results. The purpose is not only to store water in the soil but to prevent the winterkilling of trees. Experience has shown that it is not best to apply much water to orchards during the latter part of the growing season, since it tends to produce immature growth which is easily damaged by frost. In many of the orchards of Montana no water is applied in summer irrigation after August 20. Owing, however, to the prevalence of warm chinook winds, which not only melt the snow in a night, but rob the exposed soil of much of its moisture, one or two irrigations are frequently necessary in midwinter.

The Agricultural Experiment Stations.

Many inquiries have reached us at times during the past years for information concerning the various experimental stations, and we have concluded to publish regularly hereafter, the following list, which gives the state, the name of the college, also the names of proper official at each station with whom to communicate when information is desired. We trust that our readers may derive some benefit from this plan.

ALABAMA—
College Station: *Auburn;* J. F. Duggar.*
Canebrake Station: *Uniontown;* F. D. Stevens.*
Tuskegee Station: *Tuskegee Institute;* G. W. Carver.*
ALASKA—*Sitka:* C. C. Georgeson.†
ARIZONIA—*Tucson:* R. H. Forbes.*
ARKANSAS—*Fayetteville:* C. F. Adams.*
CALIFORNIA—*Berkeley:* E. J. Wickson.*
COLORADO—*Fort Collins:* C. P. Gillette.*
CONNECTICUT—
State Station: *New Haven;* E. H. Jenkins.*
Storrs Station: *Storrs;* L. A. Clinton.*
DELAWARE—*Newark:* Harry Hayward.*
FLORIDA—*Gainesville:* P. H. Rolfs.*
GEORGIA—*Experiment:* Martin V. Calvin.*
GUAM—*Island of Guam:* J. B. Thompson.†
HAWAII—
Federal Station: *Honolulu;* E. V. Wilcox.†
Sugar Planters' Station: *Honolulu;* C. F. Eckart.*
IDAHO—*Moscow:* W. L. Carlyle.*
ILLINOIS—*Urbana:* E. Davenport.*
INDIANA—*Lafayette:* A. Goss.*
IOWA—*Ames:* C. F. Curtiss.*
KANSAS—*Manhattan:* E. H. Webster.*
KENTUCKY—*Lexington:* M. A. Scovell.*
LOUISIANA—
State Station: *Baton Rouge.*
Sugar Station: *Audubon Park, New Orleans.*
North Louisiana Station: *Calhoun.*
Rice Experiment Station: *Crowley;* W. R. Dodson (*Baton Rouge*).*
MAINE—*Orono:* C. D. Woods.*
MARYLAND—*College Park:* H. J. Patterson.*
MASSACHUSETTS—*Amherst:* W. P. Brooks.*
MICHIGAN—*East Lansing:* R. S. Shaw.*
MINNESOTA—*University Farm, St. Paul:* A. F. Woods.*
MISSISSIPPI—*Agricultural College:* J. W. Fox.*
MISSOURI—
College Station: *Columbia:* F. B. Mumford.*
Fruit Station: *Mountain Grove;* P. Evans.*
MONTANA—*Bozeman:* F. B. Linfield.*
NEBRASKA—*Lincoln:* E. A. Burnett.*
NEVADA—*Reno:* J. E. Stubbs.*
NEW HAMPSHIRE—*Durham:* J. C. Kendall.*
NEW JERSEY—*New Brunswick:* E. B. Voorhees*
NEW MEXICO—*Agricultural College:* L. Foster.*
NEW YORK—
State Station: *Geneva;* W. H. Jordan.*
Cornell Station: *Ithaca;* H. J. Webber.‡
NORTH CAROLINA—
College Station: *West Raliegh;* C. B. Williams.*
State Station: *Raleigh;* B. W. Kilgore.*
NORTH DAKOTA—*Agricultural College:* J. H. Worst.*
OHIO—*Wooster:* C. E. Thorne.*
OKLAHOMA—*Stillwater:* B. C. Pittuck.‡
OREGON—*Corvallis:* J. Withycombe.*
PENNSYLVANIA—
State College: T. F. Hunt.*
State College: Institute of Animal Nutrition; H. P. Armsby.*
PORTO RICO—*Mayaguez:* D. W. May.†
RHODE ISLAND—*Kingston:* H. J. Wheeler.*
SOUTH CAROLINA—*Clemson College:* J. N. Harper.*
SOUTH DAKOTA—*Brookings:* J. W. Wilson.*
TENNESSEE—*Knoxville:* H. A. Morgan.*
TEXAS—*College Station:* H. H. Harrington.*
UTAH—*Logan:* E. D. Ball.*
VERMONT—*Burlington:* J. L. Hills.*
VIRGINIA—
Blacksburg: S. W. Fletcher.*
Norfolk: Truck Station, T. C. Johnson.*
WASHINGTON—*Pullman:* R. W. Thatcher.*
WEST VIRGINIA—*Morgantown:* J. H. Stewart.*
WISCONSIN—*Madison:* H. L. Russell.*
WYOMING—*Laramie:* H. G. Knight.*

*Director. †Special agent in charge. ‡Acting director.

Reclamation Notes

CALIFORNIA.

An irrigation district embracing 3115 acres on the Bear River near Wheatland was organized at a meeting of the Board of Supervisors early in November. The land lies in both Yuba and Sutter counties.

Twenty-five thousand acres of land will be irrigated in the Lowery section of Tehama county as soon as the big irrigation system now being installed on the Gallatin and Finell lands is completed. The system will be completed early in 1912. Eventually the system will cover 50,000 acres. The dam on Elder creek will be 500 feet across the top and will be built of solid masonry.

The great dam in Mokelumne River near Woodbridge, has been completed and will supply water to irrigate 60,000 acres of land in the vicinity of Woodbridge, Lodi and other fruit districts in northern San Joaquin county.

H. L. Gradon, a civil engineer of Oroville, has filed a notice of location on 20,000 inches of water in Middle Fork of the Feather river, to be diverted just below the mouth of Brush creek, and used for power and irrigation.

A. D. Cutler has filed a claim on 5,000 inches of water in the Sacramento river at a point six miles south of Red Bluff. The water is to be taken from the river by a pumping plant and to be used for irrigation and domestic purposes in Tehama and Glenn counties.

W. H. Hanscom of Oroville has filed an appropriation on 1,500 inches of water from Big Chico creek. The articles of appropriation set forth that the water is to be used primarily for the generation of electric power; secondly, for irrigation and domestic use.

Thomas Brothers of Merrillville are constructing a dam and a reservoir back of their ranch near that place. The reservoir will have a capacity which will allow the irrigating of several hundred acres of land.

A party of government engineers under the direction of W. H. Cole, chief engineer of the Indian Irrigation service, is at work on the Mission Indian Reservations of Southern California. These reservations represent thirty separate tracts of land, and they are to be improved with irrigation works for the benefit of the Indians.

The San Ysidro Association of San Diego will take over the business of the Little Landers corporation. To finance the deal the association will form an irrigation district, bond it for $20,000 and build its own water plant. The district will embrace 30 acres of mesa land, a large body of bottom land and a townsite. It is claimed that there is ample water in the bottom lands, and that with proper irrigation every portion of the colony site can be watered.

COLORADO.

The particulars of the contract between the Bent-Powers irrigation district and the Southwest Construction Company have been made public and are of much interest to those holding land in the district. The document provides that at least 80,000 acres must be included in the district. The land all lies within what is commonly termed the Lamar district and is immediately adjacent to that town. A dam is to be built across the Purgatoire river, and also a dam for what is known as reservoir No. 2. The main laterals are to be constructed by the Southwest Construction Company at a cost not exceeding $60,-(00, the laterals, headgates, bridges, etc., are not to cost in excess of $25,000, and the rights of way to be procured

by the construction company are not to cost in excess of $75,000 unless paid for by the district. The entire work is to be completed within a period of three years from date work is begun.

Over 11,000 acres of rich land, the nucleus of an irrigation system, which will eventually make productive 100,000 acres, located near Hudson, is involved in suits in the Federal Land Office. Over thirty contests have been filed against entrymen and women, and if the government sustains them, thousands of dollars will be lost to the settlers and the growth of the country retarded for several years at least, as appeals will be taken before farms already under cultivation are given up to contestants. In 1906 the Hudson Reservoir Company was formed to bring water from the western slope out to Barr creek and then on to the land. The law provides that if water was not gotten onto the land in four years the filers had to relinquish their lands to the government. Most of them failed because the irrigation company could not raise the money on bonds or stocks to bring the water down. A Denver firm of lawyers, seeing the future of this country, when the big irrigation project is completed, took advantage of the delay in bringing the water to the land in four years, and have secured people to make new filings on every claim.

The hearing of testimony in the suit brought by Fred Bass and others, and the Bob Creek Farmers' Protective Association against the Twin Lakes Land and Water Company has commenced. The action was brought because the Twin Lakes Company, it is alleged, is guilty of having sold far more water-rights than can possibly be accommodated. It is charged that the full capacity of the reservoirs and the actual supply has long since been disposed of. It is said that the ditch is not carrying the water prescribed, in accordance with the agreements with the farmers and that they are not getting as much water as they are paying for.

The first plant for irrigation by pumping on a large scale has been completed at Orchard Mesa, near Delta. Water power is used to turn a 48-inch turbine, and this furnishes power for the big pump which will raise the irrigating water 200 feet to the top of the mesa. At present the plant has a capacity of 400 acres, but can easily be enlarged to furnish water for 2,000 acres. As fast as capital can be secured the plant will be enlarged to take in this additional land.

A large irrigation project, embracing 1,000,000 acres of land in Morgan and Phillips counties, will be financed by Greeley capitalists, associated with Denver and Omaha men. The company is soon to be incorporated as the Narrows Reservoir and Irrigation Company and has a capital stock of $25,000,000. The company expects to get water to the land under their contract for $25 per acre. Surveys have been made and approved by State Engineer Comstock. A reservoir is to be formed by throwing a twelve-foot dam, 1,000 feet long across the Platte river, just over the line of Weld county in Morgan county. The dam will be concrete and will supply a main ditch 60 feet wide and fifteen feet deep, with a carrying capacity of 8,000 cubic feet per second. The ditch will be 65 miles long and when completed, will be of cement.

The election held in the Sedgwick Irrigation District to vote $670,000 in bonds to ratify the contract with the Camfield Development company to construct the reservoir and ditches for the system resulted in a favorable vote on all propositions. The district comprises 19,000 acres of land in Logan and Sedgwick counties, on the south side of the South Platte river.

The Alfalfa and Sugar Beets Land Company has filed articles of incorporation, with a capital stock of $50,000. The head offices of the company will be at Pueblo, while the lands owned by the organization are located in Otero county. The company has 500 acres of land on the Arkansas river directly adjoining the town of Swink. This land will be divided into 5, 10 and 25-acre tracts and sold to easterners, who are looking for such opportunities in Colorado, and especially in the Arkansas valley.

The Two Buttes Reservoir and Irrigation canal which was built under the provisions of the Carey Act, and which was begun two years ago, was completed on November 26th and turned over to the company, which was incorporated for the sale of land under the project. The project embraces 20,000 acres of land situated in southeastern Colorado, principally in Banca county.

Grover and Denver men, under the name of the Grover Reservoir & Irrigation Company, are working on a system of irrigation which will convert the territory surrounding Grover from a dry farming district into an irrigated region. The company has secured valuable water rights, including springs between the Larson ranch, south of Grover, to Cheyenne, besides flood waters of Crow creek.

The Mesa county irrigation district has placed an order with the Engineering Company of Denver for a new centrifugal pump, to be used in supplying water to the 8,000 acres in that district. The pump is to be installed by February 15th. If the pump operates successfully a second of even larger capacity will be installed. The two pumps combined will have a capacity of 19,000 gallons per minute.

Jas. T. Macey, of Denver, has filed maps and statements for the Grosvenor irrigation system with the county clerk. The system will include a pumping station, underdrains and ditches, with a diverting dam, all costing $6,600. Water will be obtained from Sand creek and the land to be reclaimed is in the southern part of Weld county.

Twenty-four entrymen under the Laramie-Poudre irrigation project, who were in danger of losing their claims through contests, have been assured by Secretary of the Interior Ballinger that the contests against them will be dismissed. The decision states that there was no evidence of fraud and that if the irrigation project is carried out it will bring water to the land. The entrymen were given further time to make final proof.

J. M. Ginrich, of Denver, will build an irrigation system for the purpose of watering 1,000 acres of his 46,000 acre ranch north of Greeley. A shallow well will be built across a creek to catch the underflow, which underlies most of that territory. The well will be but from 12 to 15 feet deep, but will be 150 feet long and four feet wide. Short piling will be driven in it to stop the underflow and force it to the surface. Here it will be pumped to the land by a gasoline engine.

The Beaver Land and Irrigation Company with holdings near Penrose has completed the Schaffer dam, which is conceded to be the most practically built and most

economical in water distribution of any in the country, owing to its underground cement pipe system of conveying water to the ranches on Beaver Park. The Schaffer reservoir, now called Lake McNeill, was started in February, 1909.

IDAHO.

The Lewiston-Clarkston Improvement Company of Lewiston has made a contract for the purchase of 85,000 feet of pipe to be used in rehabilitating the irrigation system in Clarkston and Vineland.

The work on the Snake River Irrigation Company's project is progressing rapidly. The project will furnish water to several thousand acres of fine land on Dead Ox flat, which lies between Payette and Weiser.

The promoters of the Dry Creek Irrigation project have made the statement that the reclamation of 20,000 acres of desert land in Ada county will be undertaken as a private enterprise. The system, as proposed, contemplates a storage reservoir at a point four miles above the land to be irrigated, where there is a natural reservoir site. Here a dam 150 feet high will also be built. The water of Dry Creek will be used during the months of June and July, at which time there is said to be sufficient water for the entire tract under the project.

The Pacific Land and Water Company of Salt Lake City, Utah, has filed on the flood waters of Raft river, in the southern part of Idaho, and will shortly commence work on a project whereby 55,000 acres of land will be brought under irrigation. A portion of the land to be reclaimed belongs to the company, while the balance belongs to the farmers in this district. A dam of concrete, rock and earth is to be constructed, which will have a capacity of 80,000 acre feet.

NEW MEXICO.

Incorporation papers have been filed with Terrtorial Secretary Jaffa by the Aztec Irrigation Company of Colorado, with offices at Aztec. The capitalization is $500,000.

Work has started on the irrigation system which will furnish water for Nolan, Mora county, and the surrounding country. A corps of surveyors are now at work on Lake Charette, which will be the head of the system, laying the line for the graders. From the lake the water will be carried through a tunnel 1,730 feet long into the Ocate. From there it will be taken out further down the creek, where a large canal will carry it to the farms.

The south half of the tract of land owned by the French Land and Irrigation Company, containing 25,000 acres, will be formed into an irrigation district and turned over to the farmers. The farmers will incorporate under the Territorial Irrigation Law. They will also build another reservoir with a capacity of 12,000 acre feet.

Actual work has been started on a hydro-electric pumping-for-irrigation project at Alamogordo, with an initial cost of $60,000, which it is believed will develop into a big thing for that section and reclaim large tracts of land at a small cost.

Territorial Engineer Sullivan has approved the application of the Red River Land and Water Company, of Red River, Taos county, for 629 second feet of the flow of the Red River. This company will reclaim 45,000 acres of land in Taos county at a cost of $500,000.

OREGON.

Senator Abner Weed of Siskiyou county, California, is the owner of 20,000 acres of land in the northern part of Klamath county on the Wood river, and he is now constructing a series of irrigation ditches, by means of which he will reclaim many of the acres which he owns.

The farmers of the Upper Klamath Irrigation project have become tired of waiting for the Reclamation Service to put water on their lands and many of them are installing their own irrigation plants. The source of the water supply is Lost River.

Messrs. Edwards and Shears of Portland are backing an irrigation project, which, if carried out, will be of great benefit to the land owners and others of the Durkee section. It is proposed to construct a dam or reservoir on Burnt river to conserve the waters of that stream to be used when most needed for irrigation.

The Furnish ditch, belonging to the Inland Irrigation Company, of Echo, has been completed, and the filling of the reservoir will be started upon the arrival of the flood season. The water thus stored will be used during the summer months in irrigating the 10,000 acres of land embraced in the Furnish-Coe project. This ditch has been five years in building. The preliminary surveys and final location was completed in 1906. The ditch is 30 miles long and was constructed to deliver 112 cubic feet of water per second, being capable of irrigating 13,000 acres of land at a rate of 120 acres to one cubic foot.

John C. White, of Pittsburg, Pa., who has made his home at Roseburg for the past year, has had a surveying party at work locating the route of an irrigation ditch 42 miles in length, with which it is proposed to irrigate 20,000 acres of land in the upper South Umpqua and Cow Creek valleys in Douglas county. It is estimated that the system will cost $800,000.

An irrigation project which will embrace 4,000 acres of land in the north end of Summer Lake Valley is being promoted by the Ana River Company, of which R. B. Jackson, of Paisley, is the president. The company has a paid up stock of $20,000.

The Wheeler Land and Irrigation Company have filed an application at the Lakeview Government land office for

a large reservoir site at a point where Dry creek flows into Goose lake. The company expects to be able to water 5,000 acres of land within the next year. A large dam will be built across the mouth of the stream, where it leaves the hills to enter the valley.

An irrigation project embracing 100,000 acres of land near Crescent will be commenced early in 1911. All the necessary surveying has been completed. Water will be taken from Crescent and Fish lakes. It is rumored that the project is fathered by the Hunter Land Company of Portland, who own about half of the land affected.

UTAH.

The Wastach Irrigation Company of Heber has filed amended incorporation articles with the secretary of state providing that the company's indebtedness may be increased from 10 per cent to 50 per cent of the par value of the capitalization, or 2,120 shares.

F. H. Lott of Denver has asked for the temporary withdrawal of 30,000 acres of land lying within the Vernal and Salt Lake land districts, which he is desirous of developing under the Carey Act. The temporary withdrawal will protect it from other interests for one year. The land has been surveyed and the surveys are now in the department at Washington. The estimated cost of the project is about $1,000,000. Some work has already been done upon the irrigation scheme and it is the intention of the promoters to have the whole tract ready for settlement during the summer of 1911.

The Carey Act project of the Spanish Valley Water and Land Company, with offices at Chicago and Salt Lake City, has been approved by the State Land Board. The project takes in about 8,000 acres of land in Grand and San Juan counties. Water will be taken from Mill and Brumley creeks, tributaries to the Grand River. The cost of the project is estimated at about $710,400. The land embraced in this project lies in Spanish Valley, about 4,500 feet above sea level.

WASHINGTON.

Farmers in the vicinity of Walla Walla plan to bring water from the Touchet river to water 20,000 acres of land in the lower Eureka Flat country. The estimated cost of the undertaking is $100,000.

L. M. Rice, W. H. Smith and I. L. Mossman, of Olympia, have filed on 400 cubic feet of water per second of the Nisqually river. The purpose of the promoters is to furnish water to irrigate between fifty and one hundred thousand acres of land lying east and south of Olympia.

The secretary of the interior has awarded the contracts for the construction of 40 miles of main laterals of the distribution system on Wide Hollow branch of the Yakima irrigation project to Nelson Rich of Prosser.

Engineers in the employ of the Klickitat Irrigation and Power Company are camped at the headwaters of the Big Klickitat, east of Mount Adams, where they will remain all winter. They will ascertain the winter run-off of water in that section and obtain the exact data of the flow of the Big Klickitat river. It is stated by engineers that 4,000 feet of water will be required to cover the 300,000 acres of land in the Horse Heaven country in Klickitat, Yakima and Benton counties. The project will involve a concrete lined canal 122 miles long, with three large primary laterals, aggregating 200 miles. The estimated cost of the project is $12,000,000.

Under the management of the United States Reclamation Service work on the Prosser syphon has been begun. The syphon will tap the Sunnyside Canal, 1¾ miles north of Prosser, and will cross the Yaquina river at this point, and will, when completed, water all lands under the old Prosser Lake & Power Company's lands.

Advices from North Yakima are that the Electric Bonds and Shares Company, the Pacific Light and Power Company and eastern capitalists will expend $90,000,000 in extending and improving the Hanford and Strahorn irrigation projects, which are to be consolidated.

Ten thousand acres of land known as the Whitestone Flats will be watered by the project now under way, under the direction of C. M. Zediker of Brewster.

J. G. White & Co. of New York are developing 20,000 acres of fruit land in the Upper Columbia River Valley in Stevens county, 125 miles north of Spokane; $2,300.000 will be expended in development work. This includes the building of the town of Marble, which will have a model electric light, power and waterwoorks system. Water for irrigation is taken from the Columbia river.

The Okanogan Irrigation and Improvement Company began work November 15th upon a project to irrigate 16,700 acres of semi-arid land in north central Washington. It is estimated that $300,000 will cover the cost of the project.

J. M. Ellingsworth of Lincoln, Neb., is planning the extension of the Bollinger irrigation ditch, by which 12,000 acres of brush lands in Methow valley will be reclaimed. The lands are incuded in the Pateros, Tupper, Antoine and Howard flats. Eighteen thousand acres of land in other parts of the valley are already under irrigation.

The first irrigation pumping project undertaken south of the Snake river and west of Lewiston is nearing completion and will be placed on the market early in December. President Bryan of the Washington State College is at the head of the project. Water is drawn from the Snake river by two 75 horsepower engines. The tract embraces 300 acres, and will be sold in small tracts of 5 and 10 acres.

Articles of incorporation have been filed by the Kettle Valley Power and Irrigation Company, with a capitalization of $500,000. The main office of the company is located at Republic. Incorporators are Henry B. Russell and Joseph Manly.

The city council of Walla Walla has been informed by Flinch and Campbell, owners of Blalock orchards, that they have instructed their attorneys to withdraw their suit for $25,000 damages for the use of water. The company used water from Mill Creek for irrigation purposes and claimed that the city's use damaged them. They now state that they are using artesian water for irrigation and do not need the water from Mill creek.

The Pasco irrigation ditch was opened on October 14th. The water for the big ditch comes from the Snake river through a 20-mile pipe line, which was built for the irrigation of 16,000,000 acres of orchard land. The power used in the pumping is generated at a large power plant located 110 miles up the Natchez river in Idaho.

Articles of incorporation have been filed by the Deer Lake Land & Irrigation Company of Spokane, with a capitalization of $40,000. The incorporators are Peter Gardiner, W. R. Eisenhour and M. M. Eisenhour.

The Secretary of the Interior has granted extensions of time ranging from 15 to 45 days for completion of the contract of Messrs. George Cook & Sons of Spokane, Washingtn, on the Tieton irrigation project. The engineers report that the contractors were delayed owing to the inability of the government to secure promptly rights of way from the owners whose lands were crossed by the laterals and ditches, and also to the material increase of the amount of work required.

The Columbia-Clarke Land Company of Spokane has filed articles of incorporation. Capital stock, $22,000.

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SISTER DIRECTRESS, DEPT. A

St. Mary-of-the-Woods, St. Mary's, Vigo County, Indiana.

ing of Cheyenne, Wyoming, is the chief engineer, but deputized Mr. Wolfard to do the field work.

A unit of land, approximately 12,000 acres, in the Big Horn basin, is to be thrown open to settlement by the government on February 1st. There are 132,000 acres in the basin which the government is bringing under irrigation, and 30,000 acres have already been thrown open to settlement. A nominal price of $45 per acre is charged for the water rights.

Capital for the completion of the Oregon Basin irrigation project near Cody has been pledged by Chicago capitalists, at a meeting held recently in Cheyenne. The project embraces 150,000 acres of land in the Big Horn basin, and covers land as far south as the town of Greybull. The Oregon Basin reservoir which has a natural capacity of 440,000 acre feet will be used for storage purposes. The water will be conducted to the reservoir from the south fork of the Shoshone river, thirty miles away, by a series of canals and tunnels. The reservoir is located near the town of Cody. It is estimated that it will require $2,500,000 to complete this project, which was begun by the Big Horn Basin Development Company a few years ago.

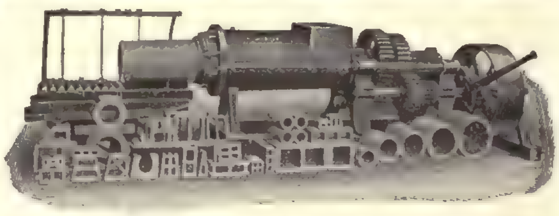
MISCELLANEOUS.

A. Y. Walton, Jr., Terrell Bartlett, Willis Ranney and Duval West, all of San Antonio, Texas, have filed on all of the unappropriated waters of the ordinary flow, the underflow, and the storm and rain waters of the Medina river and its tributaries, comprising a watershed of approximately 700 square miles and covering all the valley lands in the counties of Medina, Bandera, Kerr and Kendall. The syndicate will construct dams and a system of canals and ditches for irrigating more than 150,000 acres of land.

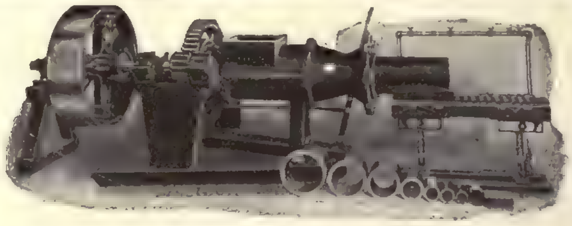
(Continued from page 694.)

lines of the chemistry of agriculture have been given. Even to do that it was necessary to concentrate a mass of matter from a multitude of books, lectures, personal experiences of successful farmers, and from other sources, to reach simplicity and clearness. The books are full of never-ending disputes over theories, doctrines and scientific experiments, relating to plants and the soil, and it was thought best to eliminate all those disputes and present the operations of a nature with regard to the soil and plants in as simple a manner as possible.

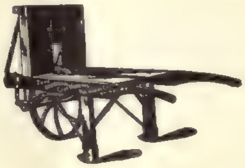
There are many things mysterious in nature which science has not yet been able to explain, and which practical experience accepts without inquiring into reasons or causes. Why do early potatoes often reach maturity and the vines die down before the latter have a chance to blossom? What is the answer to the problem of seedless fruits, such as oranges, lemons, grapes, etc.? Why do certain plants revert to originals which have few traits in common, like the tomato, for instance? Why do not the seeds of plants always produce the same variety? We know that the laws of chemistry are practically immutable, though their manifestations may be irregular. What has been written, it is hoped, will be of some benefit toward preparing for the practical articles which will follow from month to month.



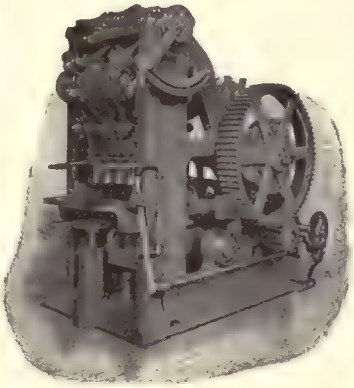
Centennial Auger Machine



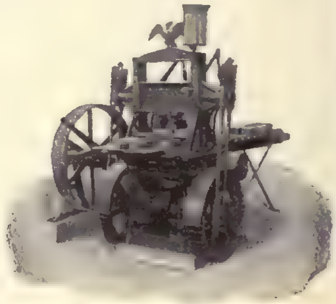
Mascot Auger Machine



Wheelbarrows and Trucks

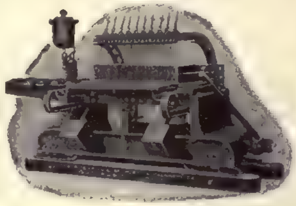


Dry Press, 5 styles

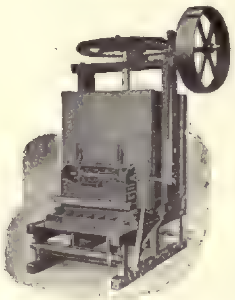


Eagle Repress

Dry Cars, all kinds



Hand and Power Cutters



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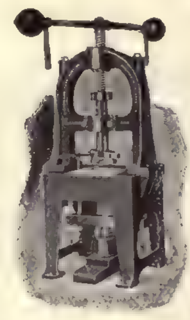
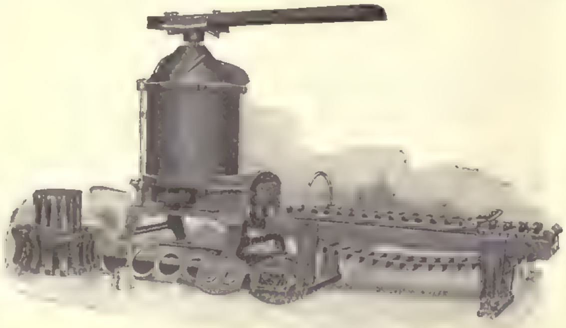


Hand Power Screw Press

Disintegrators



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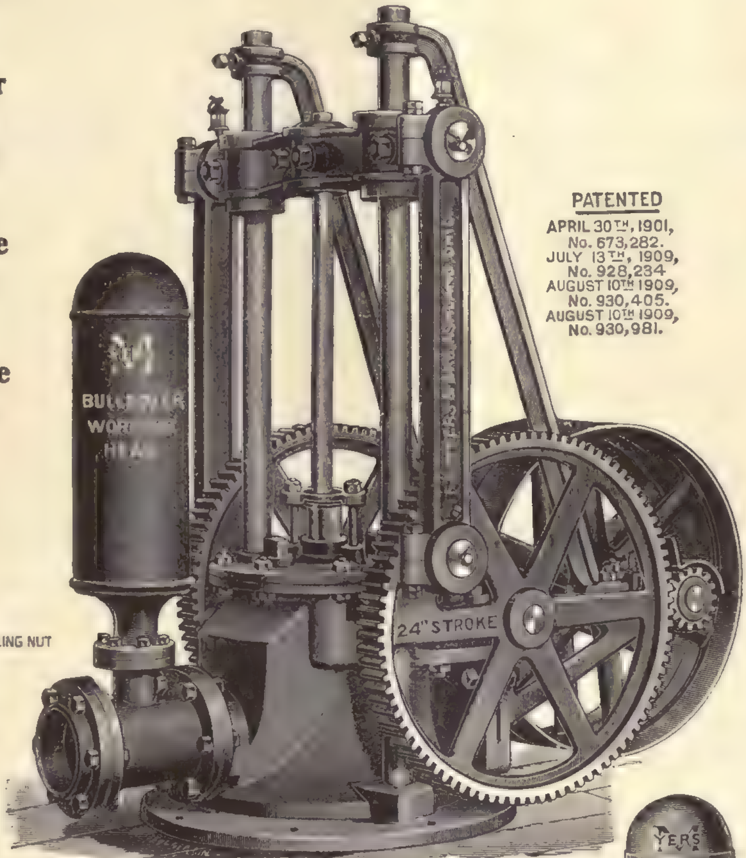

PATENTED
APRIL 30TH, 1901, No. 673,282.
JULY 13TH, 1909, No. 928,234
AUGUST 10TH 1909, No. 930,405.
AUGUST 10TH 1909, No. 930,981.

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Size of Discharge Up to 4 inches

Capacities 600 to 7200 Gallons per Hour

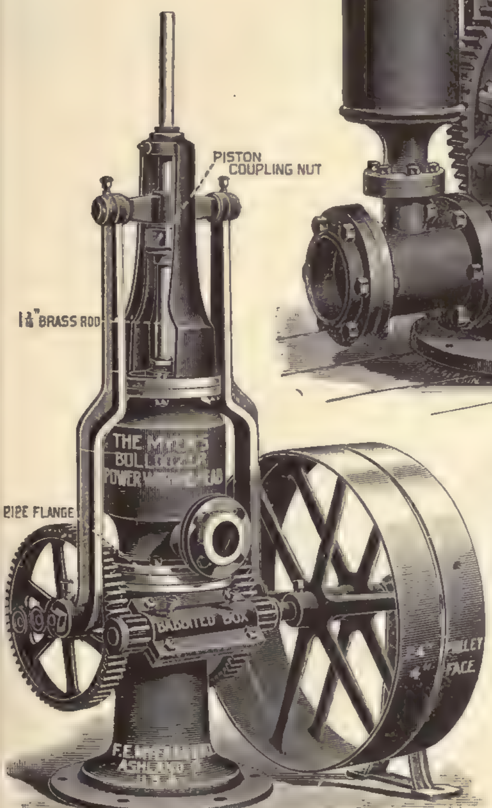

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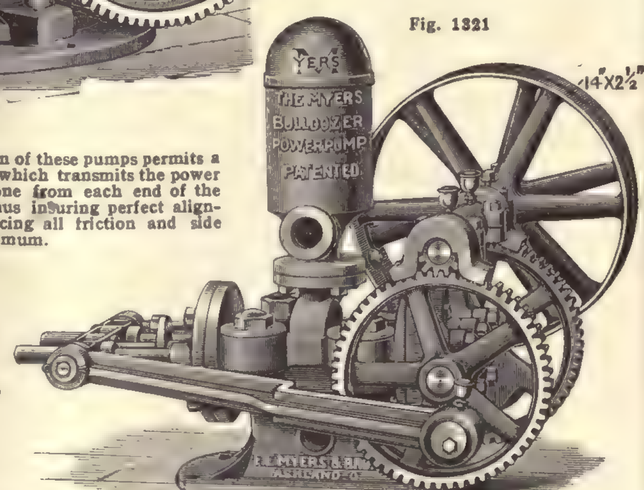
Fig. 1321



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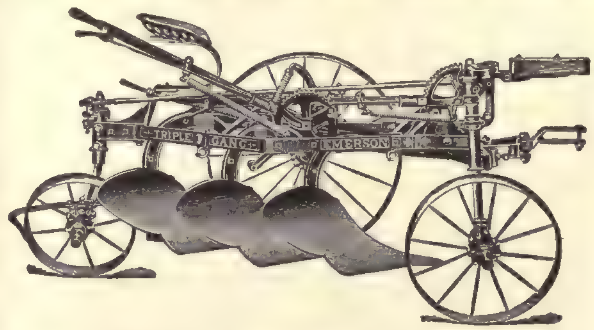

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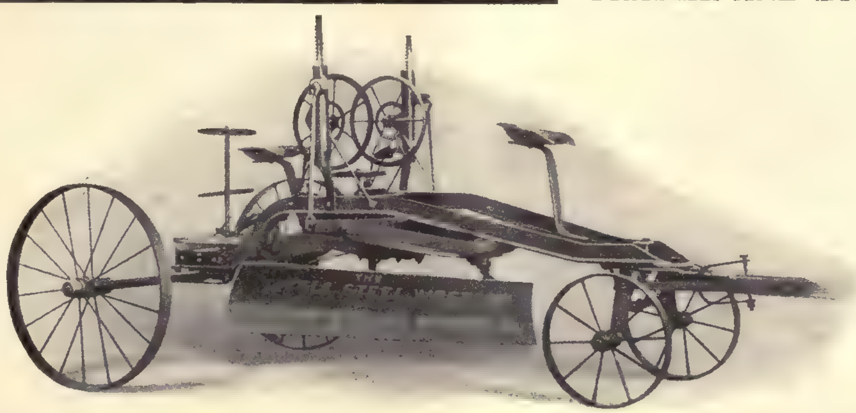

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Twenty-sixth Year

THE IRRIGATION AGE

VOL. XXVI CHICAGO, JANUARY, 1911. NO. 3

THE IRRIGATION AGE

With which is Merged

MODERN IRRIGATION — THE DRAINAGE JOURNAL
THE IRRIGATION ERA — MID-WEST
ARID AMERICA — THE FARM HERALD

D. H. ANDERSON
PUBLISHER,
112 Dearborn Street, - - CHICAGO

Entered as second-class matter October 3, 1897, at the Postoffice at Chicago, Ill., under Act of March 3, 1879.

D. H. ANDERSON, Editor

ANNOUNCEMENT.

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Official organ of the American Irrigation Federation. Office of the Secretary, 212 Boyce Building, Chicago.

Announcement.

Our readers will note that with this issue THE IRRIGATION AGE appears under the sole ownership of D. H. Anderson, the present editor. The last of the outstanding stock of the Irrigation Age Company has been taken over by the present owner, and the line "D. H. Anderson, Publisher," takes the place of the Irrigation Age Company, Publisher.

The present owner has been interested in the publication since shortly after its formation, and has been in control since 1899, but, as above stated, had not secured control of all of the stock until recently. This slight change will make no difference in the editorial or business conduct of the paper.

Death Toll of Aviation Horrifies the World.

The aviation death toll is altogether too high. The world is horrified at the sacrifice of human life. It is clear that science has not advanced far enough in the principles of aviation to justify public use or exhibitions of airships. The death record for three years goes to prove that air navigation is a hopeless failure or that its principles have yet to be studied and mastered by the world of science. Whichever conclusion suits the opinion of the public, there should be no more exhibitions until greater safety is assured.

In 1908 there was but one death among the aviators; in the next year there were four; in 1910 the appalling total of forty was reached. Nearly every day in December brought a fatal accident. Moisant and Hoxsey were killed on the last day of the year, the former while exhibiting at New Orleans and the latter at Los Angeles, where he had just established a new record for high flying. The world does not require this sacrifice of life; it cannot afford it. Public exhibitions should cease until inventors have provided a machine that is more surely controllable and dependable than any that so far have been produced.

Frequency of Drouths Perplexing Country.

For three years the Upper Mississippi Valley has suffered from devastating drouths which perplex and alarm the country. A decided change in atmospheric conditions is taking place. It is a change for the worse and there is no prospect of improvement. Weather conditions this winter continue abnormal, the lack of water being a serious menace to farming interests. Following the destructive drouth of summer there is occasion for widespread study and apprehension.

Theories vary as to the cause of these destructive drouths. It may be planetary changes, forest destruction or just chance. We only know that agriculture is not and cannot be prosperous without water and there is no system by which farmers can have irrigation in those states which are depended on to produce the wheat supply of the world.

If these states are to retain their population and maintain their property values an artificial supply will have to be provided. It will take the assistance of capital to bring this about. Furthermore, if the standard of American farming is to be raised, with a view to larger

crops, regular yields and increased exporting power, the older farming lands of the country will have to be irrigated.

Irrigation is too commonly thought of as a species of fancy farming needed only in the strictly arid regions of the Far West. This mistake has cost grain growers a great deal of money. An artificial water supply is as much needed in our grain states as anywhere else. While it is important in the fruit orchards, alfalfa fields and truck farms of the Far West, it is a vital requirement on the grain and dairy farms of the Mississippi Valley.

It frequently has been pointed out in these columns and is a fact easily demonstrated that scientific farming will yield twice the ordinary profits. Irrigation is the first essential in improving agricultural methods and placing a farm on a modern basis. This statement will be accepted without question wherever irrigation has been tried, but thousands of farmers in the Mississippi Valley do not seem able to grasp the fact that it applies to themselves. Study and observation covering a quarter of a century convince IRRIGATION AGE that the artificial water system is the great need of farming interests everywhere. Without the adoption of this method American agriculture cannot reach the high level at which representative land owners aim.

Western Farmers Lose by Bad Checks.

Western farmers are pestered with petty swindles of all kinds and the fraudulent bank check is the worst evil of the lot. As this kind of crime is increasing people who live some distance from a bank should adopt a rule that they will not accept checks unless they know beyond a shadow of doubt that they are good.

Persons living some miles from a bank will frequently carry a check for a week or a month before presenting it for payment. This is a dangerous custom, as it gives the drawer time to take his money out of the bank and disappear. The law does not protect a person who does not get his checks cashed promptly. The courts of Illinois make many absurd rulings on this point, even against the bankers themselves, as witness the case at Chadwick wherein the bank loses $550 because it was a day or two later in collecting the check than the court thought it ought to have been. A resident of Polo gave a check on one of his home banks to a farmer residing near Chadwick. The latter indorsed the paper and secured the cash for it from the First National Bank of Chadwick, the bank officials knowing the farmer and supposing him to be reliable and responsible. Such transactions are as common as eating three meals a day. The deal was for a span of horses and the bank had no interest in the matter. The check was cashed as an accommodation by an innocent party. Almost any citizen of Chadwick having that amount of money at hand would have been willing to cash the check just as the bank did.

Before the check reached the Polo bank the drawer had taken all of his money out and disappeared. The farmer was asked to make good the amount which the bank at Chadwick had paid to him, but refused to do so. In the suit that followed it was shown that the check would have been honored at Polo had it reached the bank there on the day after it was drawn, but as it did not arrive for collection for three days, the Chadwick bank was held to be guilty of negligence and is compelled tc bear the loss.

Under this legal absurdity no person is safe from imposition. The common sense view of the case in question is that the man who received the check for his team was the one cheated. The funds were in the bank when the check was made, but the maker hurried home, drew his cash and fled. The seller of the team was not in fact paid, but he took a check which proved to be worthless and by indorsing it got the amount from an innocent third party. The man who drew the check worked a confidence game, knowing that the paper would not in the ordinary course of business get to Polo for collection until he had time to return home and draw out all his funds. The appellate court holds, however, that the bank must lose because it did not rush the check through for collection.

We have too much legislation and too many laws, but nevertheless there is urgent need of some common sense amendments to some of the existing statutes.

Duty of Capitalists Toward Irrigation.

American capitalists ought to take a much more personal and direct interest in irrigation and other subjects pertaining to agriculture than they have been doing. They all tell the farmer that he needs to raise larger crops on his present acreage, not only for his own profit but for the good of the nation's export trade. Larger crops can come only through better methods of farming, and if the financial men are in earnest they must help in a practical way to put agriculture on a business basis. This means irrigation, for there is nothing else that will insure heavier crops year after year.

It can be claimed in truth that there never has been a time when bankers and other men of means have given as much attention to farming matters as they are doing at present, and yet there is an evident need of more capital in land development. It has come about that the importance of successful agriculture as related to other commercial affairs is better understood than ever before. Capitalists today realize that there can be no real or lasting prosperity in this country unless the farmer is prosperous.

In this new understanding of the proper relationship of all other business to agriculture there is hope for the farmer and hope for the continued progress of this nation. Farming must be raised to a better standard if we expect to remain an exporting country. With our land nearly all occupied we have barely raised wheat enough the past season to supply our own needs. Another drouth or two would make us importers of breadstuffs. Unless we can draw largely on Europe one year after another on export account our national prosperity must begin to dwindle.

While agriculture as a whole is prospering, it is still far from resting on a business or scientific basis. In thousands of cases capital is needed and organized effort is needed to enable individuals and even townships and whole counties to modernize farm methods. This is a thing that must be accomplished to make farming attractive to progressive young people. The greatest need of the commercial world today is the full employment of our agricultural lands. Intelligent men must take up the problem and give to it the attention that its importance demands. We require intensive, diversified farming, on business principles, with waste and slovenly or old-fashioned methods cut out. Here is a golden opportunity for capitalists with idle money. There are thousands of farmers who need help in changing over to a new system

and there are thousands of city families that would be better off on land and who could make a success of farming if properly started. Throughout the central west as well as in the far west there is urgent need of irrigation and the use of capital in this direction can be made highly profitable. Irrigation is the first step toward better farming. It is the first move to be made in putting agriculture on a scientific and practical basis. It is sincerely hoped that the time has come when American capitalists will grasp the opportunity to do a great and sensible work for the cause of progressive agriculture. They can best do this as land owners if they will employ a sufficient amount of capital to properly equip their farms, to irrigate them, to systematize their work and to raise the grade of rural labor by the means of higher wages, shorter hours and better social conditions generally. In addition to this there are many ways of encouraging the earnest and progressive farmers who wish to remain in the country, but who need the help of city capitalists in changing over from the old to the new methods. While IRRIGATION AGE claims that our men of money have a duty to perform in the way suggested we claim with equal sincerity that they can employ their capital in this way and be sure of a large return for its use.

Governor Eberhart Decries Farm Waste.

A trenchant and timely protest against land waste and poor farming was made by Governor Eberhart of Minnesota before a gathering of bankers in Chicago a few days ago. Observing people everywhere agree with the governor that one of the pressing demands of the time is for better farming. In the course of his speech he said that the waste in this country from the careless handling of the soil amounted yearly to upwards of five hundred million dollars. This is a dollar an acre on the half-billion acres under cultivation. Instead of being too high this estimate ought to be at least two dollars an acre, or a total of one billion dollars. With reference to the duty of capitalists and business men he said:

"The time has now come when every citizen must feel more keenly his duties and responsibilities with reference to the great heritage of unsurpassed natural resources that our nation may forever remain the greatest agricultural, industrial and commercial nation in the world."

Governor Eberhart made a strong picture of the unattractive life on the average farm for young men and women, and he added: "Although I have presented a sad picture it is not pessimistic. The background is altogether cheerful. Two words express the most simple and effective remedy, 'intelligent farming.' This will not only make farming profitable, but it will surround the home life on the farm with so many attractions as to remove all desire for the deceptive allurements of the city. Intelligent farming does not only guarantee good dividends on a farm investment, but it builds good roads to save cost of transportation, consolidates rural schools, where intelligent farming, industry and home economics can be taught by precept and example, beautifies the home and its surroundings, and fills it with all the attractions that elevate manhood and womanhood, teaches the younger generation the dignity as well as the reward of farm labor, and inspires the laborer with a hopeful expectation of a bright future."

CRITICISES STATE LAWS

Nebraska State Engineer Simmons Recommends Change in Statutes.

In his report recently submitted to the Governor, E. C. Simmons, state engineer of Nebraska and secretary of the state board of irrigation says:

"Perhaps the most important amendment required by our present laws is made necessary by reason of the opinion of the supreme court in the case of Farmers' Irrigation District vs. Frank (72 Neb. 136). In that opinion, Sec. 28, Art. 2, of the irrigation laws, was construed to give a person or corporation to whom an appropriation had been allowed the exclusive right to irrigate the lands included in the appropriation.

"It is the opinion of many eminent jurists that this is essentially wrong for it gives to the appropriator a vested interest in lands to which he has no title. The ownership of land should be held paramount and superior to the right to water the same.

"The present law, allowing the applicant to include in his appropriation large tracts of land without the knowledge or consent of the owners, should be so amended as to give these owners a voice in the matter. Without a reasonable amount of land to be watered, there cannot be much incentive to invest capital in a ditch; therefore, extreme care should be used to frame such a law as will be just and equitable to all concerned."

For District System.

"The district irrigation system, properly conducted, is the one that is most permanent and economical and the one which experience has shown will, in time, control most of the irrigation in this state. The system is based upon the power of the district to borrow money and issue bonds. The law should be carefully revised, with special view to protect the territory within the district bondaries from exploitation and at the same time secure those who may purchase bonds based upon the faith of the borrower.

"More than five hundred claims for water previous to the law of 1895 have been adjudicated. In several cases no physical work has been performed. Upon perhaps one-fourth of this number, excavation and construction has not been prosecuted beyond turning a few furrows. Few, if any, can be considered fully completed. Vast areas of land, aggregating thousands and thousands of acres have been listed in these claims, to which water has never been applied; yet, under the ruling (of the supreme court) this land cannot be included in any other application. The board is powerless to grant relief. The attorney general should be directed to institute proceedings in the proper courts to remove this restriction. Claimants who cannot, or will not, water the land listed in their appropriations should be forced to step aside and give some one else a chance.

"The different water divisions should be districted by this board without waiting for a petition as provided in secton 33, article 2, and the under assistants appointed early for the whole state, so that they will know their duties and be prepared to act when scarcity of water prevails and quick work is necessary.

"Every under secretary should be furnished by the owner of each canal with a list of the officers and owners, a list of the land to be irrigated and a daily bulletin of the intake at the headgate, so that especially in times of shortage, the under assistants can be properly instructed. Headgates with locks and seals and measuring flumes are necessary in enforcing the law of priority."

MEXICAN COMMISSIONERS INVESTIGATE.

Engineers working in the interest of the Mexican government are completing surveys on the mammoth project on the Yaqui River in Sonora. Mexican commissioners made an investigation recently to determine whether or not the government should finance the proposition. The proposed dam will be 180 feet high and impound a body of water forty miles in length. It will be located at Angustora, twenty miles south of El Tigre. About 500,000 acres will be reclaimed.

The Drainage Problem

BY ALBERT R. BEYMER, Drainage Engineer, Rocky Ford, Colo.

Drainage dates back to a very early date. We have records in history where drains were constructed by the Assyrians as early as the eighth or ninth century B. C. Some of the drains built at Rome in the seventh century B. C. are still doing their work after a lapse of 2,500 years. With the fall of the Roman Empire drainage suffered the same retrogression which befell learning and science and for a thousand years it was forgotten. In the fourteenth and fifteenth centuries attention again came to be paid to drainage in a small way, but not until about four hundred years later was drainage work done with any science. In about 1810 considerable scientific drainage was done in England and the burned clay drain tile introduced. Modern methods and engineering has developed almost entirely since 1850, especially in the last ten years, and still is in its infancy. The next twenty years will see more land reclaimed by drainage than all time before.

Drainage problems are not local or confined to any one state. The Mississippi Valley states have the greatest areas of wet land, while the irrigated states of the West have the least; for example, in California there are 3,420 acres of wet land; in Illinois, 925,000 acres; Indiana, 62,500 acres; Iowa, 930,000 acres; Michigan, 2,947,439 acres; Missouri, 2,439,600 acres; Nebraska, 512,100 acres; North Dakota, 200,000 acres; South Dakota, 611,000 acres; Texas, 2,240,000 acres; Washington, 20,000 acres; Wisconsin, 2,360,000 acres; and in fact all the states of the Union have more or less wet land that needs only draining to make it worth from $40 to $1,000 per acre.

Some of the most valuable land in the irrigated West has gone to seepage and alkali on account of the excess water used in irrigation and from the seepage from the main canals. More and more each year is becoming worthless as the ground becomes saturated with the irrigation water which comes to the surface in places, causing the alkali to become deposited on the soil as the water evaporates. The only remedy for such a state of affairs is drainage. This must be done intelligently and the work laid out by a competent drainage engineers. Even then the engineer should have had plenty of practical experience. In our irrigated country, Colorado, for example, the most common cause of seepage is gravel dikes which are found in the irrigated valleys. These dikes generally traverse the valley lengthwise and end abruptly. The water flows faster through this gravel than through the finer stratas and when these gravel dikes are cut off or end, the water is there cut off and has no other outlet than by rising to the surface, causing seepage. This water takes up the salts of the soil which are deposited on the surface in the form of alkali.

A thorough investigation of the cause of the seepage is essential to intelligent drainage. The underground stratas must be prospected and the course of the flow of water cut off. In the case of the gravel dikes the method of sinking a well in the end of the gravel bed and connecting this well by a tile line to proper outlet has proven very successful in a great many places. This method was devised by Prof. C. G. Elliott, Chief of Drainage Investigation, U. S. Agricultural Dept. I have known two such wells to reclaim 80 acres of very bad alkalied land which was so wet it would mire a horse. The tile lines connecting the wells with the outlet were laid about eight feet deep at the well. This land today is worth $300 per acre—all on account of intelligent drainage. In most countries where the volume of water is not too great, drainage by tile lines is preferable to open ditches. The first cost of the tile is of course much greater, but the maintenance (of the open ditch) in after years more than offsets this cost.

Great care should be used in the selection of tile. No porous tile should be used. A few years ago farmers and engineers recommended tile that water would percolate through, but these were found to last only a year or so, while hard burned tile have been known to be in good condition after a lapse of 100 years. Cement tile in particular should be impervious to water, especially that containing alkali. A cement tile that is made with a wet mixture of concrete will last in any kind of alkali water. I have known cement tile to be in fine condition after twenty years use. But the secret is water-tightness, the drainage water entering through the joints between the tile. Care should be taken in quicksand and soft ground to protect the joints of the tile; a concrete band placed over the upper two-thirds of each joint is a good sceheme. Crushed stone, gravel or a plank saddle should be placed under the tile in such ground and a perfect grade maintained. Straight lines are best with a silt box at each angle.

Roots very often obstruct the tile and wires should be strung through the tile from one silt box to another. A 4x4 pine block 3 feet long, slightly sharpened at both ends and driven full of spikes make an ideal cleaner when dragged through the tile, but always commence at the lower end. Dragging the cleaner in from the lower end a short distance, then back to the lower end, going farther in each time until the next silt box is reached.

One tile line laid deep and in the proper place will do more execution than a dozen laid at random. Under ordinary conditions six feet can be reached without difficulty. I have used a 10-ft. steel rod, sharpened at one end, for a number of years, to prospect the underground stratas. This can be worked down into the ground quite easily with the aid of a little water now and then if there is no water on the surface.

The cost of draining the seepage land of the West runs from $10 to $25 per acre. The value of understanding the fundamental principles of drainage, in preventing the increase of seepage lands and the reclamation of those now affected, can not be overestimated. Millions of dollars could have been saved in the irrigated West if the injurious results of seepage water and the methods of preventing them had been known and heeded. Eighty per cent of the seepage lands in the West and the swampy land of the Mississippi Valley and the Southern States can be profitably drained.

Reclamation by drainage has only begun. The drainage of the southern swamps would be through large canals which would be used to transport the products of the country to the river harbors or railway stations.

Holland is the most striking example of reclamation of land by diking and draining. During the last three hundred years something more than 200,000 acres of rich alluvial land have been made productive. The magnitude of some of the districts of America, which need draining, would be better appreciated were the fact known that in the states of the lower Mississippi Valley there are several drainage districts, any one of which is from two to five times larger than all the land reclaimed along the coast of Holland. Considering all the land of the lower Mississippi Valley states which can be profitably drained the area is more than fifty times greater than the reclaimed lands of Holland.

President Taft Approves Engineers' Report

Allotment of $20,000,000 Raised By Certificates Is Announced—Board Tentatively Distributes Reclamation Fund

President Taft has approved and submitted to Congress the report of the special board of army engineers appointed by him last June to examine the various reclamation projects started by the Government, and to recommend which of them should be given a share in the $20,000,000 of certificates of indebtedness authorized by the same act.

In its report the board recommends the allotment of the money among the following projects:

Salt River, Arizona	$ 495,000
Yuma, Arizona and California	1,200,000
Grand Valley, Colorado	1,000,000
Uncompahgre, Colorado	1,500,000
Payette-Boise, Idaho	2,000,000
Milk River, Montana	1,000,000
North Platte, Wyoming and Nebraska	2,000,000
Truckee-Carson, Nev.	1,193,000
Rio Grande, New Mexico, Texas and Mexico	4,500,000
Umatilla, Oregon	325,000
Klamath, Oregon and California	600,000
Strawberry Valley, Utah	2,272,000
Sunnyside, Yakima, Wash	1,250,000
Tieton, Washington	665,000

The board also made a tentative allotment among various projects of the general reclamation funds for the years 1911 to 1914, inclusive. This is to supplement the $20,000,000 loan and to carry on projects which do not participate in the distribution of the loan. The projects to share in this money are as follows:

Yuma	$2,380,462
Grand Valley	500,000
Uncompahgre	2,045,000
Minidoka	528,000
Payette-Boise	4,585,435
Huntley	110,000
Milk River	2,950,000
Sun River	3,278,000
Lower Yellowstone	578,000
North Platte	2,185,000
Truckee-Carson	1,594,000
Rio Grande	1,855,000
Missouri, pumping	270,000
Belle Fourche	480,000
Okanogan	13,000
Shoshone	2,000,000

Of these, the amounts allotted to Grand Valley, lower Yellowstone and Missouri pumping are conditional. The total amount of this fund will be $25,351,897.

No allotments either from the loan or from the general reclamation fund were recommended for the following projects, except for necessary maintenance and operation: Orland, Cal.; Garden City, Kan.; Kittitas, Wapato and Benton, Yakima project, Washington; Carlsbad, New Mexico, and Hondo, New Mexico.

In his letter to the Secretary of the Interior approving the report of the engineers President Taft says in part:

Approval Is Not Final.

"I hereby approve the report of the board of engineers in respect of the reclamation projects to which they have made allotments from the $20,000,000 loan; but this approval, as far as the amounts of the allotments are concerned, is not final and absolute, but is intended to be subject to change by adjustment and modification of the amounts as may be necessary for the intelligent and proper prosecution of the work and to the advantage of the service.

"You are authorized to call upon the Secretary of the Treasury to issue the certificates of indebtedness needed to furnish the funds in accordance with the allotment recommended by the board and approved by me as the same shall be needed from time to time in pursuance of the terms of the act.

"The remainder of the report of the engineers, which was not responsive to the direction of the law but was drawn at my request and for my information, I hereby approve; and when congress reconvenes in January I shall submit a message to the two houses, transmitting the report announcing my approval of the same and urging the adoption of enabling legislative measures recommended by the board."

Board Praises Engineers.

In its comprehensive report on the reclamation work in general, the engineers' board says in part:

"The engineering structures of the various projects are, as a whole, well designed and well built. Some of them, as the Pathfinder dam, the Shoshone dam, the Roosevelt dam and the Gunnison tunnel, are monuments reflecting great credit on both designer and builder.

"Modern irrigation being a relatively new art in this country, much freedom was allowed local engineers in the design of minor structures. While this was a wise policy in the early stages of the work, it has resulted in some complicated and unnecessarily expensive structures. With the present knowledge of the comparative merits of the different types, it is believed that standard designs of the simplest, satisfactory type should be adopted for all minor structures.

"The most uncertain feature of nearly all the projects is the water supply. This is under state control, and in the prosecution of its work the reclamation service bears the same relation to the state as a private individual or corporation. Where the water rights have been adjudicated, the rights of the United States are well defined, but elsewhere they are uncertain and may prove to be materially different from that assumed.

"It is recommended that, wherever possible, steps be taken to secure an early adjudication of water rights on all projects where such adjudications have not yet been made, and that, pending such action, expenditure be kept within the probable rights of the United States.

Cost Exceeds Estimates.

"The actual cost of completed work has almost invariably exceeded the original estimates, and in the case of some structures has been two or three times as large. This increase in cost has been the cause of much of the discontent among the settlers. It was partly due to a general increase in the cost of labor and materials, partly to underestimates and an insufficient allowance for con-

tingencies, and partly to the necessity of doing more work than was originally contemplated."

Under existing regulations, the report sets forth, the construction charges must be returned to the reclamation fund in ten equal annual payments. This, it is said, is regarded as a hardship by the settlers on some projects, who express a desire for a series of graduated construction payments, increasing from 1 per cent or 2 per cent the first year to 14 per cent or 15 per cent the tenth year. Should this suggestion be generally adopted, it is pointed out, it would mean a delay of several years in the return of the first half of the investment and a corresponding delay in the completion of other work.

"On some of the projects in the semi-arid regions," say the engineers, "such a modification in the terms of payment may be necessary to prevent an absolute failure of the project, but the general adoption of a system of graduated payments is not believed to be necessary or advisable."

SPECIAL MESSAGE ON RECLAMATION.

President Taft Recommends "Surplus Water" Act and Suggests Change in Water Rights Payments.

In a special message dealing with reclamation problems, President Taft says:

"The act of Congress, approved June 17, 1902, set apart as a fund for the reclamation of arid lands the moneys received from the sale of public lands in certain of the states and territories, except the 5 per cent of the proceeds of such sale theretofore set aside by law for educational and other purposes. The receipts into the reclamation fund to June 30, 1909, were $58,439,408.93, and the estimated total receipts to June 30, 1910, are $65,714,179.06. The total amount accumulated in the fund to date is estimated at $69,449,058.76, of which all but $6,241,058.76 has been allotted to the several projects.

Reclamation Funds Not Sufficient.

"The additions to the reclamation fund from the sales of public land, while approximating between $6,000,000 and $7,000,000 per annum since 1902, were found to be insufficient for the completion of the existing projects with such expedition as the necessities of the settlers and land owners within the projects undertaken seemed to require.

"I accordingly recommend the issuance of certificates of indebtedness or bonds against the reclamation fund. The act of June 25, 1910, which authorizes the issuance of not exceeding $20,000,000 of certificates of indebtedness, repayable out of the reclamation fund, made the appropriation subject to the conditions that it should be expended on existing projects or their necessary extensions, and as no part of the same should be expended until after the projects had been examined and reported upon by a board of army engineers.

"No new projects have been undertaken since March 4, 1909, the efforts of the government having been directed toward the completion of the thirty primary projects theretofore undertaken.

"After careful consideration of the report of the board of engineers, I approved the same, believing that it sets forth a plan for the distribution of the loan and of the available reclamation fund that, from any engineering and economic standpoint, will best secure the speedy completion of those particular projects.

Urges New Legislation.

"Pursuant to the recommendations of the Secretary of the Interior and of the board of army engineers, I earnestly recommend the enactment of a law which will permit the disposition of any surplus stored water available from reclamation projects to persons, associations, or corporations operating systems for the delivery of water to individual water users for the irrigation of arid lands, and the enactment of legislation which will give executive authority for the modification of conditions of payment for water rights on certain of the projects where, by reason of local conditions, the return of the cost of the projects to the reclamation fund will not be secured unless settlers are permitted to make payments on terms or conditions other than those specified in the public notices heretofore issued."

MOLINE PLOW COMPANY.

In another column of this paper will be found the advertisement of the Moline Plow Company. The Flying Dutchman farm tools are used on the model farm of the Irrigation Age at Fountain, Colo.

THE GOLDEN STREAM.

A very commendable little booklet of 68 pages, called "The Golden Stream," has been recently issued by the International Harvester Company of America.

This booklet covers a multitude of vital facts relative to the plain, ordinary, everyday cow in a very interesting manner. Such up-to-date topics as "The Dual Purpose Cow," "Bovine Tuberculosis," "How to Make a Babcock Test," "Rations for Dairy Cows," "The Feeding Value of Silage," and "Advantages of Dairy Farming," etc., etc., are discussed. In general, the purpose of the book is to impress the farmer with the proper relation of the cow to our modern civilization as the source of a golden stream of wealth.

Numerous illustrations throughout the booklet showing record-making cows and herds of various milking breeds, silos, dairy barns and interiors, etc., greatly enhance the value of the booklet. It will be greatly appreciated, especially by farmers and dairymen. A copy of the booklet may be obtained by writing the company or any one of the various I. H. C. branch houses.

EASY LIFT PLOWS.

Every reader of this publication should investigate the merits of the Emerson Easy Lift Plow. It's a plow that's built for our boys on the farm and is one of the greatest improvements ever made in an agricultural implement. It is the lightest draft plow made—easiest on man and team. The raising levers are controlled by the feet, leaving the hands free to manage the team. These levers are so rigidly constructed and so powerful that a boy can easily force the plow bottom into the hardest ground or lift it out of the toughest sod, even though the team is standing still. With most plows—if the bottom is raised you have to swing round and come back in the furrow to avoid leaving a bad spot in the field. The hand levers for regulating depth and leveling are placed on the right hand side on the Emerson. This avoids throwing weight on the land wheel and makes it much easier to operate. There are so many good points on the Emerson plows that we can't begin to tell you all about them here. Your boys and your hired men will all be interested in these plows because they enable you to do more work and do it easier than the old way. Send for free catalog and learn all about the Emerson line. Address Emerson-Brantingham Co., 47 Iron St., Rockford, Ill.

National Association of Land Men is Formed

Organization Will Aid in Development of Land—Demand for Membership Shows Rapid Growth

"To promote the general welfare of those engaged in the development, reclamation, management, cultivation or sale of land in the United States; to encourage, by agitation and co-operation and the exploitation through the public press and by land shows, produce exhibitions, and in all other legitimate ways, the movement of the people back to the land; to maintain a union of legitimate land men for the purpose of exposing and preventing frauds in land sales and immigration and protecting investors and its members alike from imposition; to use its influence in securing legislation in the United States and the several states to protect the producer and public from frauds; and to assemble in one central organization, all those interested in the development, sale and cultivation of land, the procurement and transportation of emigration and the sale of any and all the products of the land, for mutual co-operation."

With these objects—as set forth in the application for a charter under the laws of the State of Illinois—the National Association of Land-men sprung into existence on December 17. Organization was the outcome of a meeting called for this purpose by men who are actively interested in the "back to the farm" movement and who have foreseen the need of organization for mutual assistance and for carrying out policies of benefit to the fraternity and to the public.

That the organization has found a responsive chord among land men, officials and others who are interested in the sale of land to people now crowded into the cities, is evinced by the rapidly growing demand for membership. With the organization yet in its infancy it may be predicted that it is to enjoy a strong and rapid growth. Need for concerted effort and co-operation among land men has long been recognized and it is fair to conclude that the National Association of Land Men will fill the need.

At the meeting held in Chicago on December 17 the following officers and directors were elected:

OFFICERS.

JAMES PORTER, President, President Porter Land Co.

D. H. ANDERSON, Secretary, Proprietor Irrigation Age.

D. J. SPLANE, Treasurer, Gen. Manager Artesia Land Association.

A. B. HULIT, Business Manager, Manager National Land Journal.

S. B. PUGH, General Counsel.

DIRECTORS.

James Porter (President Porter Land Co.), Reinbeck, Ia., and Marquette Bldg., Chicago.

F. E. Goodall (Arcadia Orchards Co.), Spokane, Washington, and 184 South Clark St., Chicago.

D. H. Anderson (Publisher IRRIGATION AGE), 112 Dearborn St., Chicago, Ill.

R. N. Magill (Secretary Lower Rio Grande Valley Association Publicity Bureau), Brownsville, Texas.

Fred R. Reed (General Agent Twin Falls North Side Investment Co.), Wendell, Idaho.

H. N. Nichols (President Valley Planters Company), 1247 Marquette Bldg., Chicago, Ill.

S. B. Pugh (Attorney firm of Dandridge & Pugh), 1210—134 Monroe St., Chicago, Ill.

A. B. Hulit (Manager *National Land Journal*), 112 Dearborn St., Chicago, Ill.

John C. O'Neill (President The North Laramie Land Co.), 1202 Marquette Bldg., Chicago, Ill.

W. A. Riddle (Manager The Riddle Company, Florida Lands), 1212 Steger Bldg., Chicago, Ill.

R. G. Loffler (Manager The Catholic Colonies, Stratton, Colo.), 193 Michigan Ave., Chicago, Ill.

R. S. Butterfield (Director Nevada Eastern Land Co.), 404 Merchants Loan & Trust Bldg., Chicago, Ill.

E. Burton Waterman (Oregon Orchards), Medford, Oregon.

D. J. Splane (Manager The Artesia Land Association), 817—134 Washington St., Chicago, Ill.

H. B. Hening (Secretary Bureau of Immigration), Albuquerque, New Mexico.

Of the fifteen directors named above the first five will serve for a term of one year, the second five for two years and the third five for three years. The principal place of business will be in Chicago where meetings of directors will be held upon proper call.

In announcements sent to land men throughout the country the Association presents the following "Declaration of Principles":

Whereas, Those now engaged in the occupation of the development, reclamation, management and colonization of lands and promotion of the movement of the people from the crowded cities "back to the farm" have now no recognized national organization;

And whereas, For the purpose of co-operation and the carrying out of the purposes and principles set out in our charter, such an organization is a great necessity, not only for the assistance of those engaged in such occupation but also for the encouragement of the movement and the protection of land purchasers as well; therefore, we declare the following as our initial purposes in the organization of our association:

First: To procure through such a mutual organization the concerted action of the public press and the public men of our country in giving the widest publicity to the advantages of farming in general. To carry out such purposes it is proposed that as soon as details can be arranged, we will establish a publicity bureau with a competent man in charge and will secure interviews with prominent men and all the data pertaining to the general subject in hand and prepare same for the daily and weekly press of the country.

Second: That we will advocate the idea of having the United States Government through the pure food bureau of the Agricultural Department assume charge of the inspection and marking of all fruits and vegetables which are intended for commercial purposes. The idea of such inspection being to prevent the possibility of dishonesty in remarking or regrading products from the various states, in order to give the public the same security in the purchase of different farm products as is now given them in the purchase of other foods.

Third: We propose further to advocate the idea of having each state pass a law requiring all real estate men and land men to procure a state license before they can transact business, with a provision in such laws that if

a party holding such license or permit is found guilty either in the state or federal courts of perpetrating fraud in any real estate transaction, that such license or permit be revoked by the proper authorities, also providing that no other license or permit shall thereafter be issued to such party by the state.

Fourth: To provide at such time as our organization is properly perfected for that purpose a department which may receive complaints against dishonest land companies or individuals and to investigate the same, giving to them the approval or disapproval of this association. And also at the request of any member of the association to investigate the proposition in which such member is interested, upon terms to be provided for, and to report upon such proposition upon its merits. On this proposition the intention of this association shall be to act absolutely without prejudice and to use all efforts to attain a standing as an authority among land men, land buyers, financiers and financial men in general, as other trades and professions now have in their lines.

Fifth: It is a further purpose of this association to do all in its power to see that any of its members who shall at any time be prosecuted for fraud or otherwise, or who are liable to be so prosecuted, shall have a fair trial and the power and finances of this association shall be used for that purpose. And, if the association shall itself find that such member is guilty, the power of the association shall be used to assist in his prosecution and he will be debarred as a member of the association.

Sixth: It shall be a further purpose of this association to co-operate with the press and other organizations of the country in promoting all kinds of land, fruit, grain and live stock exhibitions and assisting those in charge of such exhibitions not only in securing the exhibits but attendance as well, and also to assist exhibitors in securing reasonable terms, encouragement and inducements for the purpose of making such exhibits. And, if necessary for protection to the exhibitors and the public, it shall be the purpose of this association to establish and promote such exhibitions and shows through its own committees. It shall be a further purpose of this committee to create a means of intercommunication between its members.

OFFICERS AND DIRECTORS NATIONAL ASSOCIATION OF LAND MEN.

1. James Porter. 2. F. E. Goodall. 3. Fred R. Reed. 4. S. B. Pugh 5. H. B. Hening. 6. E. Burton Waterman. 7. R. G. Loffler. 8. H. N. Nichols. 9. R. N. Magill. 10. A. B. Hulit. 11. W. A. Riddle. 12. D. H. Anderson. 13. John C. O'Neill. 14. D. J. Splane.

SEEDS.

Every farmer will be interested in the new seed catalogue just issued by R. H. Shumway, Rockford, Illinois. It contains hundreds of beautiful illustrations and is a mine of information on all kinds of garden and flower seeds. Mr. Shumway has built up an immense business by giving every customer a fair deal and selling good seeds cheap.

THE PRIMER OF HYDRAULICS*

By FREDERICK A. SMITH, C. E.

Art. 1. General Properties of Matter—Continued.

Inertia.—This means that all bodies have the tendency to remain in their state of rest or state of motion, and that it takes some external force to change such state. Thus, a wagon standing still will remain standing still until some outside force makes it move; this principle is easily seen, but the other part of the claim that bodies in motion will remain in motion until stopped by some external force requires some study to prove in all cases; for instance, roll a ball along the ground and it is observed that its motion grows slower and slower and finally comes to rest. This looks at first to be a violation of the principle of Inertia, yet it is in full accord therewith, for the stoppage of the motion of the ball is caused by two external causes or forces, namely, the impenetrability of the air which offers a certain resistance to the rolling ball, and the friction upon the surface on which the ball rolls bring it gradually to a stop.

The phenomena of motion and the causes producing them will be further treated and in more detail in the article on Mechanical Principles.

Art. 2. Algebraic Principles.

A knowledge of mathematical principles is necessary for the successful application of scientific principles to practical problems. This applies also to hydraulics and in order to convey this knowledge to those who have not had it before, or to refresh it in those who have forgotten it articles 2 and 3 have here been introduced.

Algebra is a general arithmetic teaching the principles of arithmetic by the use of symbols. It is presumed that the four elementary operations, addition, subtraction, multiplication and division are known so far as common numbers are concerned and the following explanations illustrate their adaptability to algebraic symbols:

1. *Addition.*—The act of adding two or more numbers together means to find a new number which contains as many units as the two or more given numbers; thus: $7+3=10$ (read: 7 plus 3 equal 10) represents that operation arithmetically; the algebraic representation is just like it: $A+B=C$ (read: A plus B equal C) and it means that the number of units in A are added to the number of units in B and that the number C contains as many units as there are in a and b together. The numbers to be added together are called *summands* and the result of the addition is called the *sum*. Thus a and b are summands and c is the sum.

The expression $A+B=C$ is also called an equation, because the value of $A+B$ is equal to C; $A+B$ is the left side and C the right side of the equation and as the principle of equation is very important in this work the following axioms should be mastered right now: If two things are equal they remain equal if the same quantity is added to each, or if the same quantity is subtracted from each, or if each is multiplied by the same number, or if each is divided by the same number. That these principles are true is easily seen. Thus, if

$7+3=10$ then

$7+3+2=10+2$ (adding 2 to both sides),

$7+3-5=10-5$ (subtracting 5 from both sides),

$7+3\times4=10\times4$ (multiply both sides by 4) and

$\frac{7+3}{2}=\frac{10}{2}$ dividing both sides by 2; for in the first operation we have $12=12$; in the second operation $5=5$; in the third operation $40=40$, and in the fifth operation we have $5=5$. The application of these principles applies with equal force to algebraic equations as will be seen hereafter.

2. *Subtraction.*—Unknown quantities are usually expressed by the symbol X, Y, Z, etc., though any letter may be used for that purpose. If in the expression:

$$7+X=10$$

one of the summands X is unknown it is found by subtracting the other summand 7 from both sides, thus:

$$7+X-7=10-7$$

The equality of the two sides has not been disturbed by subtracting 7 units from both sides; on the left side this leaves X and on the right side it leaves $10-7$, hence:

$$X=10-7$$
$$X=3$$

This is a very important principle and the expression $10-7=3$ shows how a summand is found by subtracting the given summand from the sum. It also illustrates the principle of subtraction. The number 10 from which is subtracted is called the *minuend*, the number 7 which is subtracted is called the *subtrahend*, and the number 3 which is the result of the subtraction is called the difference.

As a general thing when in an equation all but one quantity are given then that one unknown quantity can be found. Thus, if in the above equation the number 10 was not known we give it the symbol X and then write $X-7=3$. Now, in order to find X, add 7 to both sides of the equation:

$X-7+7=3+7$

On the left side $-7+7$ cancel, hence:

$$X=3+7$$

This also shows the principle that the minuend is equal to the subtrahend plus the difference.

3. *Negative Numbers.*—In common arithmetic all numbers are greater than zero; in algebra, however, we say there are just as many numbers smaller than zero than greater than zero—or with other words there is an ascending series of numbers greater than zero and a descending series of numbers smaller than zero; the former are called positive numbers the latter negative numbers. The positive numbers are indicated by the + (plus) sign though position numbers need not have the sign affixed, thus the numbers 7 or A indicate position numbers which—7 or —A would mean negative numbers. A negative number bears the same relation to a position number as debts bear to property, thus adding a negative number to a positive number diminishes the positive number as many units as there are in the negative number. Thus: adding 4 dollars debts to 7 dollars property would leave 3 dollars property. This would be indicated thus:

$+7+(-3)=+4$

On the other hand to subtract a negative number from a positive number increases the latter as many units as the negative number has, thus:

$+7-(-3)=+10$

Also if a negative number is added to a negative number it decreases the value of that negative number, thus:

$$-7+(-3)=-10$$

And if a negative number is subtracted from a negative number it increases the value of that negative number:

$$-7-(-3)=-4$$

The value of the number—4 is greater by 3 units than the number —7. Also the sum of a positive and negative number of equal units is equal to zero, thus:

$$+7-7=0$$

4. *Multiplication.*—In a sum like: $5+5+5$ where the summand 5 appears three times the operation is indicated by writing the equal summand but once, and the number which shows how often that equal summand is present is written along with the equal summand with the symbol of multiplication, thus: 5×3 or 3×5 and the result being 15, we have:

$$3\times 5=15$$

This operation is called multiplication; the numbers 3 and 5 are called factors and the number 15 is called the product.

In a similar manner if we have the sum: $A+A+A+A$ we could say $4\times a$ or $4a$; thus, when numbers are expressed by letters no multiplication sign need to be placed between, hence, 7X means seven times X, *ab* means A times B, *abc* means A times B times C, etc. When a sum or a difference is to be multiplied by a number, each term of the sum and difference must be multiplied, and the sum or difference placed in brackets, for instance: Multiply the sum $4+5$ by 7; this should be written thus: $7\ (4+5)$; this would be equal to $7\times 4+7\times 5$ or $28+35$ which is equal to 63; this is obvious from the fact that $4+5=9$ and $7\times 9=63$; hence, if instead of given numbers we have algebraic symbols the same principles obtain, thus:

$A\ (B+C)=AB+AC$

Likewise: $A\ (B-C)=AB-AC$

This principle also governs if sums and differences are multiplied by sums and differences, for example: Multiply $9-2$ by $4+7$; $(9-2)\times(4+7)$ multiply each term of one with each term of the other, thus:

$9\times 4+9\times 7-2\times 4-2\times 7=$
$36+63-8-14=$
$99-22=77$

That this is correct is seen if, instead of $9-2$ we write 7, and instead of $4+7$ we write 11, then $7\times 11=77$.

Example: Multiply $11-5$ with $8-3$; this should be written: $(11-5)\ (8-3)$ and the result should be 30, since $11-5=6$ and $8-3=5$; multiply as above:

$$11\times 8-11\times 3-5\times 8+5\times 3=88-33-40+15=30$$

Observe that the product of two positive or two negative numbers is positive and that the product of a positive with a negative number is negative. These principles are necessary to understand when working with algebraic terms or formulas.

Thus, multiply: $(A+B)$ with $(C+D)=(A+B)\ (C+D)$ $=AC+AD+BC+BD$.

Also $(A+B)\ (C-D)=AC-AD+BC-BD$; also $(A-B)$ $(C-D)=AC-AD-BC+BD$.

When expressions occur in which like numbers appear after multiplication they are united thus:

$$(A+B)\ (A+B)=AA+AB+AB+BB$$

Where the same number is multiplied by itself, like AA and BB, it is called a square and is written A^2 or B^2; also as the number AB appears twice instead of $AB+AB$ we say 2AB, thus instead of $AA+AB+AB+BB$ write $A^2+2AB+B^2$.

This expression also illustrates an important principle that the square of the sum of two numbers is equal to the sum of the squares of the two numbers plus twice their product. To illustrate an application of this multiply 203 by 203.

Solution: Instead of 203 set $(200+3)\ (200+3)$ this is equal according to the above principle:

$$200\times 200+3\times 3+2\times 3\times 200=40000+9+1200=41209$$

Another principle is found by multiplying a difference by itself, thus: $(A-B)\ \ (A-B)=A^2-AB-AB+B^2=A^2-2AB+B^2$. This principle says: The square of the difference of two numbers is equal to the sum of the squares of these two numbers minus twice their product. Application, multiply 98 by 98.

Solution: Set $100-2$ for 98, then we have: $(100-2)$ $(100-2)=100\times 100-2\times 100-2\times 100+4=10000+4-400=9604$.

Another principle is illustrated as follows:

Multiply the sum of two numbers by their difference, as $(A+B)\ \ (A-B)=A^2+AB-AB-B^2$.

In this answer $+AB$ and $-AB$ cancel, hence the answer is A^2-B^2. This principle, expressed in words, says: The product of the sum of two numbers into their difference is equal to the difference of their squares. This is also true in the reverse way, for instance: Subtract the square of 13 from the square of 17, which operation would ordinarily require, first, to multiply 17 by 17, next multiply 13 by 13, and then subtract the latter product from the former, thus: $17\times 17=289$, $13\times 13=169$; $289-169=120$. By the aid of the above principle this problem is solved much easier as the answer will be found by multiplying the sum by the difference, thus: $17^2-13^2=(17+13)\ \ (17-13)=30\times 4=120$.

5. ***Division.***—If in a product one factor is unknown it can be found when all the other quantities are known, for instance: $3X=21$, which means to find a number which, multiplied by 3, gives 21; this number is evidently 7, because 3 times 7 equal 21, and is found by dividing 3 into 21; hence, the operation of finding a factor is called division; the operation is indicated thus:

$$X=\frac{21}{3} \text{ or } X=21\div 3$$

In this expression the number 21 is called the dividend or numerator, the number 3 is called the divisor or denominator and the number X (or 7) is called the quotient or fraction.

As $\frac{21}{3}=7$ the relation between the different terms may be expressed that the dividend is equal to the quotient multiplied by the divisor, and that the divisor is equal to the dividend divided by the quotient.

The rules for the signs in division are the same as in multiplication; thus, like signs produce positive, and unlike signs produce negative numbers, for instance:

$$A\div B=\frac{A}{B};\ A\div -B=-\frac{A}{B};\ -A\div B=-\frac{A}{B};\text{ and }-A\div -B=\frac{A}{B}.$$

This general law regarding the signs may be shortly expressed thus: Like signs produce positive and unlike signs produce negative results.

6. *Involution.*—When in a product all the factors are equal for instance, $5\times 5\times 5\times 5$, then, instead of writing the factor 5 four times, we write it but once, and the number 4 which indicates how many times said factor is to be multiplied by itself on the upper right hand of the number 5, making the number 4 about half the size of the 5, thus:

$$5^4=625$$

Which is read: 5 to the 4th power equals 625. The number 5 is called the base, 4 is called the exponent and 625 is called the power. Thus, the power is found by multiplying the base as often with itself as the exponent indicates. Thus, 2^5 means that the number 2 is multiplied 5 times by itself, or $2\times 2\times 2\times 2\times 2=32$.

Also AAAAAA should be written A^6, $XXXXXXX=X^7$.

If two powers of the same base are divided into each other, the resulting quotient can be simplified, for instance:

$$\frac{3^5}{3^2} = \frac{3\times3\times3\times3\times3}{3\times3} = \frac{3\times3\times3}{1} = 3^3 = 3^{5-3}$$

$$\frac{3^5}{3^3} = \frac{3\times3\times3\times3\times3}{3\times3\times3} = \frac{3\times3}{1} = 3^2 = 3^{5-3}$$

$$\frac{3^5}{3^4} = \frac{3\times3\times3\times3\times3}{3\times3\times3\times3} = \frac{3}{1} = 3^1 = 3^{5-4}$$

$$\frac{3^5}{3^5} = \frac{3\times3\times3\times3\times3}{3\times3\times3\times3\times3} = 1 = 3^{5-5} = 3^0$$

$$\frac{3^5}{3^6} = \frac{3\times3\times3\times3\times3}{3\times3\times3\times3\times3\times3} = \frac{1}{3} = \frac{1}{3^1} = 3^{5-6} = 3^{-1}$$

$$\frac{3^5}{3^7} = \frac{1}{3^2} = 3^{5-7} = 3^{-2}$$

From the above it appears that powers of the same base are divided into each other by subtracting the exponent of the divisor from the exponent of the dividend. Also, that a power having the exponent zero equals 1; also, that a power with a negative exponent represents a fraction with the numerator 1 and the denominator is the power with positive exponent. Illustrating the same principles upon algebraic terms we have:

$$\frac{a^{13}}{a^{11}} = a^{13-11} = a^2$$

$$\frac{a^{13}}{a^{13}} \quad a^{13-13} = a^0 = 1$$

$$\frac{a^{13}}{a^{17}} = a^{13-17} = a^{-4} = \frac{1}{a^4}$$

If two powers of the same base are multiplied together it is done by adding the exponents together, thus: $A^3 \times A^4 = A^7$, or $(B+C)^5 \times (B+C)^8 = (B+C)^{13}$.

If, however, a power is to be raised to another power like X^5 is to raised to the third power then it is indicated thus: $(X^5)^3 = X^{15}$, which means that the exponents must be multiplied.

NOTE: The second power of a number is called the square, and the third power is called the cube of such number.

7. *Evolution.*—In the expression: $4^3=64$ are three quantities, the base 4, the exponent 3 and the power 64, and if any two of them are given, the third one may be found. Involution showed how the power is found when the base and the exponent are given. Thus, the power 64 in the above term is found by multiplying the base 4 three times by itself. Suppose, however, the power 64 and exponent 3 are given and it is required to find the base 4, then the problem is to split the power 64 into as many equal factors as the exponent 3 indicates. This operation is called evolution and is indicated thus:

$$X = \sqrt[3]{64}$$

Read: X=the third root of 64; X is now called the root, 3 is the index, 64 is the radical and the sign between 3 and 64 is called the radical sign. If the index is 2 it is called the square root, and is usually omitted; if the index is 3 it is called the cube root; if the index is 5 it is called the fifth root, etc. In solving the various problems in applied hydraulics it is occasionally necessary to extract the square root, cube root, fifth and seventh root. The extraction of the square root is a familiar operation with many people, but the cube root is much more difficult, and higher roots are usually extracted by the use of logarithms. Tables of square roots and cube roots are appended, especially selected for the use in hydraulic work and the following paragraph gives hints, how to find any root by the use of logarithms.

8. *Logarithms.*—In 7 it was stated that powers of the same base are multiplied together by adding the exponents, that powers of the same base are divided into each other by subtracting the exponents, that powers are raised to another power by multiplying the exponent by the other power; inversely the root may be extracted from any power by dividing the exponent of the power by the index of the root. To illustrate these principles briefly, we will use the base 10; then:

$$10^2 \times 10^3 = 10^{2+3} = 10^5$$

$$10^6 \div 10^2 = 10^{6-2} = 10^4$$

$$(10^5)^3 = 10^{5\times3} = 10^{15}$$

$$\sqrt[7]{10^2} = 10^{\frac{2}{7}}$$

Every number can be considered as a power of 10; thus:

$1=10^0$.
$10=10^1$.
$100=10^2$.
$1,000=10^3$.
$10,000=10^4$.
$100,000=10^5$.
$1,000,000=10^6$.

Also for number smaller than 1:

$.1=10^{-1}$.
$.01=10^{-2}$.
$.001=10^{-3}$.
$.0001=10^{-4}$.
$.00001=10^{-5}$.
$.000001=10^{-6}$.

These exponents of the base 10 producing the different numbers are called logarithms. Thus, it is seen the logarithm of 1=0, the logarithm of 10=1, of 100=2, of 1,000=3, of 10,000=4, etc. So the logarithm of all numbers between 1 and 10 are greater than 0 and smaller than 1; the logarithms of all numbers between 10 and 100 are greater than 1 and smaller than 2; the logarithms for all numbers between 100 and 1,000 are greater than 2 and smaller than 3; it shows also that all logarithms are decimal fractions, except the exact powers shown.

Tables of these logarithms have been computed and a table of them is embodied into this book.

9. *Formulas.*—A formula is an algebraic expression showing how to apply a scientific principle to the solution of a practical problem. They are always in the form of an equation and most of them are simple enough to be handled correctly by anyone having a common school education. As an illustration let the box

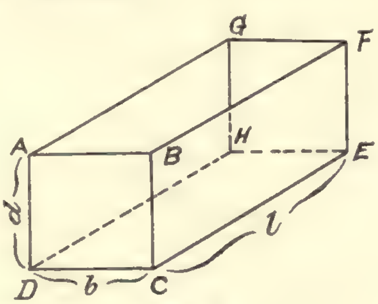

FIG. 3.

A, B, C, D, E, F, G, H, shown in Fig. 3 be of a rectangular shape; if the depth AD=3 feet, the width DC=4 feet, and the length CE=6 feet, then the volume enclosed by the box would be $3\times4\times6=72$ cubic feet, and as a cubic foot of water

weighs 62.5 pounds we could figure out quickly how much weight there would be in the box when filled with water.

If now the depth of the box is called d, the breadth b, the length l and the volume v, then the formula expressing the volume is as follow:

$$v=d\ b\ l$$

From this formula the depth d can be found by dividing both sides of the equation by bl:

$$d=\frac{v}{bl}$$

which teaches that the depth of box is found by dividing the volume by the product of breadth times the length.

Likewise, if it be required to find the breadth of a required box it would be done by dividing the volume by the product of length times depth, thus:

$$B=\frac{V}{LD}$$

and the length would be found by dividing the volume by the product of depth time breadth or:

$$L=\frac{V}{BD}$$

So the four formulas:

$$V=DBL,\ D=\frac{V}{BL},\ B=\frac{V}{DL},\ \text{and}\ L=\frac{V}{BD}$$

are all derived from the simple principles of equations which have been illustrated in this article.

TO CONSERVE WATER FOR IRRIGATION.

New Company Is Formed at Pueblo to Gather Data.

Representatives of severall Colorado irrigation projects met at Pueblo recently and took steps toward the formation of the Colorado Water Conservation Association, an organization for gathering data with a view to prevent unnecessary loss of water available for irrigation purposes.

The incorporators of the concern, the certificate of incorportation of which was filed for record, are P. J. Dugan, who is considered one of the best posted attorneys in the West on matters pertaining to irrigation; J. C. Teller, of the Teller Reservoir and Irrigation project; W. J. Lester, general manager of the Pueblo-Rocky Ford company; N. M. Tabor, of the Skinner-Tabor project; V. G. Garnett, a large stockholder in several projects.

Representatives of several other irrigation projects in the Arkansas valley are interested in the membership of the new organization. It is planned to promote legislation which will have for its object the conservation of the water of all streams in the state, and to promote economical use of the water.

Another object of the society will be the gathering of data in regard to all streams used for irrigation purposes. The principal offices of the organization will be in Pueblo. Promoters hope to make the society an active factor in preventing the waste of water, to the disadvantage of the agricultural interests of many farming sections.

Chester W. Smith, formerly engineer in the U. S. Reclamation Service, has resigned from that position for private employment in engineering work. Mr. Smith entered the service December 16, 1904, and from that time to the date of his leaving the service was in direct charge of the constructio nof the Roosevelt Dam, Salt River project, Arizona.

Land Speculation Retarding Settlement

BY W. D. HORNADAY

An analysis of the immigration statistics of the railroads show that 190 homeseekers are entering Texas daily and remaining there permanently. Not all of these new-comers go to the farm. The settling of the great unoccupied area of agricultural lands is what is wanted. Less than one-sixth of the land in that state is under cultivation, and, based on this year's crop yields and the prices obtained for the different products, the average daily income of the Texas farmers aggregated $1,545,000. The railroads that have penetrated the ranch regions where the agricultural possibilities are abundant but undeveloped are crying for more population. The statement is made that if all the people in the United States were to move to Texas, the population of that state would be less per area than that of Massachusetts.

It is estimated that of the 140,000,000 acres of idle lands in that state fully 100,000,000 acres are available for agricultural development. The remainder is rough and arid and practically worthless, even for grazing purposes. The agricultural invasion of the cattle country of the western and southwestern portions of the state has been remarkable during the last few years, but the farms are but a small part of the great scope of territory in which prosperous homes might be established, it is claimed. It is now considered a pretty well established fact, that wherever cattle raising can be carried on, farming can be done. This does away with the old theory that was given circulation by the ranchmen that their lands were unfit for agricultural purposes. The gridironing of the ranch region by railroads has just begun, and wherever these lines of transportation have been built, the "man with the hoe" quickly puts in an appearance and gradually crowds out the cattle baron. It is only along the railroads in Texas, however, that farming on a scale worthy of consideration is being done. The great areas of intervening country is still given over to the grazing of the herds of livestock.

What farming is done in Texas, is on a big scale, generally speaking. This is shown by the fact that the average farm in that state contains 357 acres, while for the whole United States, the average size is 146 acres. There are scores of plantations of thousands of acres each. The campaign for smaller farms and more intense cultivation has not been in progress very long, but it is already producing the desired results in some sections, particularly along the Gulf coast and in the lower Rio Grande valley, where the soil and climatic conditions are specially suited for growing vegetables and other products that require more work and attention than such standard crops as corn and cotton. Even with corn and cotton, it is beginning to be realized that where the acreage is smaller, better cultivation can be given the crops and much greater yield obtained.

The land problem in Texas presents some perplexing features which requires solution in order to encourage immigration in a volume commensurate with the wonderful fertility of the soil, the ideal climate and the manifold other advantages that exist there for the homeseeker. Complaint is already being made that money-seeking land agents are overdoing the thing in some localities. These men are boosting the prices of land out of the reach of the prospective investor who goes to that state in search of cheap acreage tracts with the view of settlement and development. There are

scores of colonization projects being promoted in different parts of the ranch territory. Some of these have been operated on a legitimate basis, the owners being satisfied with a reasonable profit on their investment, but there are others that have no other object than quick profit-making by the promoter, the homeseeker being left with a piece of high-priced land on his hands and many difficulties before him to be overcome, before he can hope to derive the profits and benefits to which he is rightfully entitled from the beginning.

It is the land speculator who is hurting and hindering the settling up of the unoccupied lands of Texas, it is claimed. These men purchase a ranch of ten thousand to fifty thousand acres, for prices ranging from $6 to $15 per acre, have it surveyed into farming tracts of 40 to 200 acres, and then sell this land out to the horde of land-hungry men from other states, for prices ranging from $40 to $100 per acre. The difference between the purchase and the selling price is too excessive to be legitimate. The action of these land speculators is having another effect that is far-reaching. It is causing a general boosting of prices on the part of the ranch

Clearing Land in Lower Rio Grande Valley.

owners, on a purely fictitious basis. When the fact is considered that six to eight years ago almost any ranch property in the territory south of San Antonio could have been purchased for from $3 to $5 per acre, and hundreds of thousands of acres as low as $2 per acre, and that the agricultural development since that time is hardly worth considering as compared with the enormous area of unoccupied land that is availablle for farming, the increase in the prices of these lands is in most instances unreasonably large.

In those portions of the state which have been made accessible for settlement, by the construction of lines of railway, the enhancement of land values is a natural consequence. This is true of the Gulf coast region and the lower Rio Grande valley, which have been opened up to activities of the farmer during the last six years by the establishment of a railroad transportation outlet. The region around Brownsville and extending up to the American side of the Rio Grande for one hundred miles was a terra incognito of the average citizen of other portions of Texas and people outside the state, until the railroad was constructed. Before the coming of the new road it was 160 miles from Brownsville to the nearest railroad point. The broad scope of valley land, embracing more than six hundred thousand acres, was not deemed of any value except as a range for goats, by the easy going people of the border territory. Even for a few months after the railroad was finished, the land values remained as low as $2 and $3 per acre. It was seen that the development of the valley region would require the expenditure of enormous amounts of money in the construction of irrigation systems, in order to reclaim the land from its arid state. In time this money was forthcoming from large trust companies and private individuals of the financial centers of the country, such as St. Louis, Chicago, New York and other places. In the last six years more than $25,000,000 have been expended in irrigation and land development in what is known as the Brownsville country. Water has been made available for irrigating many thousands of acres of the rich lands, hundreds of prosperous homes have been established, and a transformation of the former chaparral-covered territory accomplished that is little short of marvelous.

The increase of land values have been enormous, but the cost of making the land available for cultivation has been stupendous. The land speculator is frowned upon. In order to make it practically impossible for a person to purchase land in the valley for the purpose of holding it idle for a prospective increase in value, a minimum charge of a few dollars per acre per annum for the right to the water for irrigation purposes, whether it is used or not, is made. This stipulation forces the land buyer to bring his land under cultivation as quickly as possible. The big inducement that is bringing about the rapid reclamation of these lands, is the extraordinary large profits that are derived from their cultivation. The net revenue averages more than $200 per acre per annum, and in many cases it is as high as $500 and $600. This is on the valuation of $80 to $150 per acre for the land.

It is in the irrigated sections of the state that small farm holdings are chiefly found. In the Brownsville country, handsome annual incomes are obtained from farms as small as twenty and ten acres. The average size of these farms is less than fifty acres, it is said.

If the prices of lands in the unsettled parts of Texas can be kept down to a legitimate basis the influx of the new settlers will continue at an increasing rate, it is stated by representatives of railroads. Even at the present rate of settlement and development it will be more than three hundred years before the one hundred million acres of unoccupied lands are converted into farms, it is claimed. It is pointed out that the unoccupied domain of the state is too great for land values to go up by leaps and bounds, such as is reported from some sections of the ranch territory.

The cultivated area of Texas yields about $560,000,000 per annum. If the remaining five-sixths was in cultivation, these figures would be increased to more than two and one-quarter billion dollars.

Three million more farmers are needed, and they must come from outside the state. The statistics of the railroads show that the tide of immigration is rapidly turning to Texas, but it is not coming strong enough to make the impress that the opportunities that are offered in the state justify, according to the opinion of the men who are interested in the upbuilding of the commonwealth.

ARID AGRICULTURE

BY

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Hay and Forage Crops.

Prof. B. C. Buffum.

The Canada field pea is perhaps one of the most important and valuable crops, both for forage and grain, that has been introduced into the West. It is both valuable for irrigation farming and dry farming. In some sections the field pea has revolutionized the agriculture. This is true in the San Luis Valley, of Colorado, where the raising of Mexican field peas and the fattening of lambs on them has largely taken the place of grain farming.

There are a good many varieties of Canada peas. The Mexican is a mixed or mongrel sort, which is largely grown in Colorado. The White Canada has given us the best results in all our experiments. There are several strains of these White Canada peas. We are now growing some from Sweden, France, England, Germany and other places, and some of these strains are far more productive than the common ones obtained from Canada or Wisconsin. Other forms of field peas offered by seedmen are Green Canada, Blue Scotchman, and several forms of garden varieties, like the White and Blackeyed Marrowfat. The Golden Vine is one of the best known varieties.

At higher altitudes, where the seasons are cool, field peas do well on almost any kind of soil. At lower altitudes, where the summer is hot, the cold, heavier soils give better results. Under systems of dry farming sandy soils which retain the most moisture are the best.

Planting Peas.

Peas are a good crop for either old land or sod, and they may be planted in a variety of ways. Good results are sometimes obtained from sowing them broadcast on the sod and covering them with the breaking plow, but such method cannot be recommended. They may be disced in or planted and covered by any method used for other seeds. The best way is to use the press drill. Forced feed drills will often crack some of the seeds; but the saving made by drilling the seed is very great in spite of this fact. Many of the split peas will grow, and the seed put in the ground with a drill will be well planted. They may be sown from one inch to four inches deep.

Field peas should be planted as early in the spring as the ground can be prepared. In some places where the ground is dry, the seed may be sown late enough in the fall so that it will not germinate. At lower altitudes, where the season is long, the peas may be sown as late as the first or middle of July, and they will get large enough in the fall either to produce forage or to be plowed under to increase the humus and nitrogen in the soil. The best time, however, is to plant as early in spring as possible. February is not too early, if the ground is thawed out.

Peas are easy things to cultivate. On the dry farm, under the two-year system, all they will need is a harrowing with a drag-tooth harrow after they have come up. Under irrigation peas may be managed at the pleasure of the farmer. The pea is what the botanist calls an indeterminate grower, i. e., it grows, blooms, and ripens seed as long as there is moisture and absence of hard, freezing weather.

The amount of irrigation will depend upon the length of the season, and somewhat, also, on the heat of the summer. Where summers are hot, flood irrigating will blister or otherwise injure the pea plant. Furrow irrigation is better. They may be kept growing by irrigating often enough to keep the soil moist. We have found that on good, loamy soil four irrigations gave a yield of ripened peas of 34¾ bushels per acre, and about four tons of vines, while seven irrigations gave a little larger growth in vine, but only nineteen bushels of peas, because they did not get ripe. On account of its adaptability to different soils, different ways of planting, ease of farm management and response to dry farm methods or irrigating practice, the field pea is one of the easiest managed crops.

Feeding Value of Peas.

The pea is both forage and a grain crop. Pea hay properly made is a roughage unexcelled by any other. Poorly made pea hay is poor stuff. Good pea hay is a valuable feed for any kind of live stock. It has been found that over-ripe pea hay, pea straw, or that which has been spoiled in the stack, is dangerous to horses, cattle, pigs or sheep, because it causes indigestion and impaction. These troubles are absent when properly made and cured hay is fed. The threshed peas are highly nitrogenous food. They are specially valuable for young, growing stock. Except for lambs or pigs which have good teeth and can grind their food, peas should be chopped or ground. Pea hay which contains ripe and partly ripe peas will make the horses slick and shiny in the spring and will put good fat on any kind of stock.

In many parts of the West the cheapest and best method of harvesting the field pea is to pasture with stock. In the San Luis Valley, and other places, lambs to be fattened are turned on the pea fields early in October and allowed to run for about one hundred days. These lambs may be followed by pigs, which clean up the waste peas that have been shelled out and trampled under foot. The best method is to use hurdles, or division fences, so the stock will not run over and tramp down all the peas during the first feeding period. They should have fresh food and the best supply at the end of their fattening period, and this can only be secured by using a part of the field at a time. By this method of feeding the expense of harvesting and handling the crop is saved. All that is necessary is to see that the animals are supplied with proper water and salt.

An acre of peas that makes a good crop will feed and fatten eight to twelve lambs and leave a considerable supply of peas for the hogs which follow.

Such feeding leaves all the manure on the ground and spreads it at the same time. With the nitrogen gathering of the peas and the manure of the animals, soils used in this manner are continually enriched. Sheep will do well on peas even where some snow covers them. When the snow is too deep a plow can be run through, breaking furrows and lifting the peas so that the sheep can get to them.

Pulling or Mowing the Crop.

If it is desired to put the peas in stack, either for the saving of seed or to feed as pea hay, or to be threshed for grain, they may be pulled with the old-fashioned dump rake, or sometimes with an ordinary hay rake. If peas are mowed, a guard attachment should be put on the mowing machine which will lift the vines. A man should follow with a fork and throw the vines in bunches or wind-rows, away from the machine, so that the horses will not tramp over them on the second round.

The best method of hauling peas to the stack is by the use of sleds and slings. If threshed for seed, a special threshing machine must be used or they must be flailed or tramped out. The ordinary cylinder machine will not only split the peas, but make pea meal of them in our dry climate where the grain gets brittle.

Many eastern writers make a strong point of the value of growing field peas in connection with some grain, generally oats. It is usually claimed that the grain helps hold up the peas and increases the efficiency of both crops as food. Our experiences indicates that in most places it will pay better to grow the peas and the grain separately. The grain is apt to grow more rapidly than the peas in the early part of the season, and its effect in shading and crowding the pea vines usually produces small growth or entirely smothers them. The combination for feed of pea

hay and well cured oat or barley hay possesses important advantages, as it makes a better balanced ration.

Corn.

The West is not a corn country. The great value of corn, however, as a forage crop and as a cultivated crop for dry farming, makes it of much importance. There are parts of the West where corn can be raised for grain with profit, but its high value is as a fodder.

Corn is one of the most productive plants we can grow in the amount of roughage produced per acre. Yields of from four tons to twelve tons per acre are obtained of cured fodder. When properly raised and cared for, corn fodder is worth almost half as much as alfalfa, and it produces a large amount of digestible food per acre.

Corn is one of the best drouth-resistant forage crops, and one that can be most cheaply raised. Seed costs little, cultivation may be done on an extensive scale, and shallow cultivation is all that is necessary. The land may be plowed and cultivated more shallow for corn than for any other crop. Under dry farming, with proper tools, one man can plant and tend 160 acres of corn, or of sorghum. He must have plenty of horses, gang listers, large harrows, and gang weeders.

There are many kinds and varieties of corn, but they are all classified under about four heads. There are flour corns, usually grown in the South; Dent corns large and small, Flint corns suitable to the North, and sweet corns. The best varieties for the most of the West are those short season types represented by the Flint corns and the small Dents. Sweet corn is one of the most valuable sorts to grow for forage. It will produce almost or quite as much forage per acre as the common kinds. The best varieties for this purpose are the large growing late sorts, like Evergreen or Stowell's Evergreen.

Of the common corns those that will stand the most drouth, the shortest season, and coolest nights are the Australian Flint corns, the White Cap Dent corns, Cool Night corn and Mexican corn. Corn is one of the easiest plants to adapt to variations of soil and climate.

Corn Culture.

We recommend deep plowing for dry farming, and more shallow plowing where irrigation is done. Plowing should be as long before planting as possible in order to let the soil become packed. The usual cultivation to conserve moisture and kill weeds is important. There are two general methods of planting. Corn may be drilled in rows three or three and one-half feet apart, dropping the seed about a foot apart in the row. Or, it may be drilled more thickly for the production of fine stemmed fodder. When planted in this manner, usually from ten pounds to twenty pounds of seed per acre are sown. For dry farming the recommendation is to use a lister, planting in hills with two pounds to five pounds of seed per acre. Cultivation should begin almost as soon as the corn is planted. It may be frequently harrowed until the plants are six or eight inches high. Then it should be cultivated with a weeder until too high for this machine, after which cultivation can be done with the ordinary corn cultivators, unless there is sufficient moisture so the crop can be laid by.

Corn fodder has the highest food value when it is nearly mature. It is best to leave it until the ears are just past the glazing stage. There is considerable loss in the West of food value when corn matures. It should be put in as large shocks as possible to save this loss. It does not pay to harvest corn-stalks by turning in stock to eat them. Fodder is less valuable if left to cure in the fields, and there is considerable loss occasioned by cattle dying suddenly from corn-stalk disease. There are no bad effects from feeding cured corn fodder. Fifty pounds of corn foder when it is in best condition is said to equal seventy-five pounds of millet or sorghum.

Sorghum and Kafir Corn.

The word sorghum usually designates the sweet forms which may be grown for sugar. The common non-saccharine sorghums are called Kafir corn, or Jerusalem corn, rice corns, or Dhouras. The culture is alike for all these sorghums and the general recommendation for preparation of the land and cultivation of crop given for corn is applicable to sorghum. These plants are valuable for some parts of the West. The Kafir corns grow in the hotter, longer seasons, and the Dhouras and sweet sorghum further north. They are usually grown for forage, but the grain is of great value. Ground sorghum seed has much the same nature as corn meal and has a value only a little less than corn for feeding. The sorghums have weak germinating seeds and are slow in the earlier part of their growth. The seed should not be planted until the weather gets warm, usually after the middle of May, and level culture is better than listing, as the plants should be up where they receive the sun and heat. They should be drilled in rows, three feet apart, and when grown for forage, about one and one-half bushels of seed may be sown per acre. When grown for grain, from six to twelve pounds of seed should be used which will distribute it from four to eight inches apart in the rows. The grain may be sown broadcast and harvested with a mower for hay. The usual method of harvesting when grown in rows is but the use of either a mower or a corn binder. The yield of grain varies from twenty bushels to ninety bushels of grain in Kansas, the average being forty-five bushels. These crops will yield from four to eight tons of dry forage.

While sorghums may be more easily raised than corn, their fodder is not so valuable. They are drought resistant. They are sometimes cut early in order to produce two crops in a season. It is more advisable, however, to let the plants become more mature. If cut early, they are succulent and cattle cannot eat enough to furnish them with sufficient nutriment. They are best cut for food when the grain is in the milk or early dough stage. Dr. Headden found that good sweet sorghum gives poor feeding results compared with corn fodder or other forage.

The earliest and the best variety of sweet sorghum for general planting is the Early Amber. Early Orange is good, but it requires a little longer season. The best variety of Kafir corn is the Black Hulled White. The Red Kafir corn is usually grown where the season is long; but the Black Hulled White has given the best results in nearly all parts of the West.

Millets.

There are four distinct forms of millet. First, the Japanese millets, of which our wild crab grass is a near relative; second, the round headed millets, like the Common, German, Hungarian, Golden, and Siberian millets; third, the Pearl millets, which have round, cat-tail-like heads, and, fourth, Broom corn, hog, or Proso millets, which are drouth resistant forms.

Of these forms the Pearl millet is suitable to the South, and will not mature in our northwestern states. The proso millets will stand more drouth and produce crops of seed where others would fail, but as a forage they are not so palatable to stock as are the other forms.

On good soils, under irrigation, Japanese millet will produce heavy yields of fairly good forage. The German, Hungarian, and Siberian millet are the ones most generally recommended. Of these the Hungarian seems to be the most palatable to stock, but the German or Siberian millet will probably produce heavier yields.

Millets are quick growing, summer crops which are quite exhaustive on soils. They are not very useful at altitudes above 6,000 feet, but at lower altitudes they produce valuable hay, especially under systems of dry farming. Millet is a good crop to raise on new sod, under irrigation. Sow from thirty pounds to sixty pounds of seed per acre, and as with other small seeds, we advise the use of the press drill. Millets are good feeds for most stock, but they must be fed carefully to horses. It is better to mix millet with other hay, like oats, peas, or corn fodder.

There are several kinds of salt bush (Atriplex) growing in parts of the arid West. These plants have high feeding value and are an important part of the forage on many ranges. The Indians have appreciated these plants for their horses. In "Captain Bonneville," Irving says that many years ago old Chief Arapooish, in telling that the "Crow-Country is a good country," spoke of the value of the Salt Weed for their horses. Just what the value of the Salt sages will be for cultivation is not known, but some of them are very promising. The best native kinds are apparently Nelson's Salt Sage, Shad Scale, and the Annual Tumbling Saltweed. The one which is most cultivated is the introduced Australian salt bush. This has

proved itself of great value in California, where Prof. Charles Shinn made an extended report of it. Doctor Headden, in Colorado, has grown the plants and investigated their feeding value. He thinks this one of the valuable dry land forage crops. In California it produced over five and one-half tons per acre of fodder, where the rainfall was less than five inches per annum. This salt bush spreads on the ground, so it is hard to mow for hay, and its great value is as pasture. It becomes an annual where the winters are cold, but produces large amounts of seed, and in Colorado reseeded and maintained itself for five seasons. It is very rich in protein and takes out of the soil a large amount of mineral matter, as it contains seventeen per cent of ash. This salt bush spreads on the ground, so its seeds must be planted very shallow. It is difficult to get a stand, but after once started it grows under very unfavorable conditions. Salt sages are especially valuable for alkali soils.

White Sweet Clover.

Bokhara or white sweet clover is a plant which is much despised as a weed. Its good qualities are neither known nor understood. In our opinion it is one of the most valuable plants for certain conditions which we can grow in the West. It has qualities which make it a most desirable weed to occupy the waste places on the farm. On irrigated farms, which are properly managed, this clover never becomes a troublesome weed in the fields. It does become more or less troublesome, however, in some dry farm areas, because it is persistent and will spread even in the native sod. Its qualities are, its great hardiness; it will grow on soils too poor for other crops and also on strong alkali soils; it will stand more drouth than any other clover; it is hardy enough to produce well at our higher altitudes and is so strong in its growth that it will produce a large amount of vegetation to plow under as a green manure.

Sweet clover is one of the strongest nitrogen-gathering legumes. The bacteria on the roots of sweet clover are said to be the same as those which live on the roots of alfalfa, and soil from sweet clover land can be used to innoculate alfalfa fields with the nitrogen-gathering bacteria. We have never examined sweet clover roots without finding the nodules. On this account it is one of the very best plants to grow for enriching the soil in nitrogen.

Sweet clover makes a stock feed which is valuable if it is properly treated. Breeding this plant has been commenced with the hope of producing a variety which will not have the bitter and sweet flavor which makes it unpalatable to stock. As it is, hay properly cured and fed, give remarkably good results. A number of cattle men have testified that they had little difficulty teaching their stock to eat sweet clover hay and that they did well on it. In some experiments carried out at the Wyoming Experiment Station, sweet clover hay was fed to fattening lambs with corn and other grain, and the butcher who dressed the lambs testified that they were the heaviest and fattest he ever saw.

Sweet clover is one of the best honey plants known.

Its general appearance on a place and its values, as indicated, makes sweet clover better as a weed, filling up the waste places, than Russian Thistle, cow weed or a host of more pernicious and worthless plants.

Making Sweet Clover Hay.

Sweet clover should be planted thick. Use twenty-five or thirty pounds of seed per acre if planted for hay. It must be cut when young, before the plants get coarse and woody. The green plants are full of juice and the hay must be cured in the wind-row or in small cocks. It should be allowed to get quite dry before putting it in the stack. When stacked, sprinkle in the hay five to eight pounds of salt to each load, then let the hay stand in the stack two years before feeding it. This method of curing hay two years is little used in the United States, but it is a common practice in England to pay a premium for horse hay which is two years old. Sweet clover hay is both strong in flavor and richer in protein than any other plant we have grown. Chemical analyses in Wyoming showed eighteen per cent of protein. This indicates that the hay is very rich. On account of this richness it must be fed with care in order to make stock eat it successfully. If fed too much, animals will as quickly lose their appetite for it as they would if overfed with grain or other rich food.

Sweet clover is a biennial plant. It lives only two years and the whole plant dies. Because of this fact good farmers need never fear the plant as a weed. If not allowed to go to seed the second year it will entirely disappear. We recommend the planting of sweet clover on grease-wood, alkali or other poor soils, letting it grow only one to two feet high the second season and plowing it under to increase the vegetable mold and nitrogen in the soil.

Dwarf Rape.

Dwarf rape is one of the valuable forage plants to be grown in the West. Its use is entirely as late fall and early winter pasture. This is an alkali resistant plant of much value for such portions of the farm as are unproductive for other crops through the rise of alkali. Only dwarf rape should be planted. Other varieties have no value except for bird seed. Rape grows best in the cooler portions of the year, and although a hard frost will stop its growth, it does not destroy its value as feed. It may be planted either broadcast or in drills, using from two to four pounds of seed per acre. It is useful as a catch crop to be sown in the grain field for the production of pasture after the grain has been harvested. As a forage it is especially valuable for sheep and hogs. Cattle like and do well on rape pasture. It will not do for milch cows, because milk and butter become tainted. The dairy products will seem all right for from twelve to twenty-four hours after they are first fresh, but in a day or two they develop most unpleasant odors and flavors where rape is pastured. Rape is an annual plant, so it is necessary to sow it each year. Stock will sometimes eat too much of it if turned into a field when hungry, and in such case it causes bloat. Sow rape any time up to the first of July. No doubt the fattening qualities of rape have been exaggerated, but as pasture or a forage to be used in connection with other foods, it will give good returns for the cost of raising.

As yet Kohlrabi is little known in the West, but it is a crop which will be valuable for stock forage. It is usually grown in gardens and used as a table vegetable. Kohlrabi is one of the more drouth-resistant plants of the cabbage family, which produces thickened stems above the ground. The thickened stem and leaves are valuable stock feed. It grows with comparatively little moisture, and may be either harvested and fed to stock for soiling or pastured in the fall. The seed should be planted the same as turnips, preferably in drills, and may be planted in the early spring in the open ground or the plants raised in boxes and transplanted.

Grass for Pasture.

In the farming sections of the West, where alfalfa is largely grown, there is increasing interest in grass pastures for cattle and sheep, which will be safer than alfalfa pasture, and which will produce more than our native grass lands. The percentage loss of cattle or sheep pastured on green alfalfa is too great. Some ranchmen are becoming interested in growing early lambs for market on their farms and others are milking cows where open range is limited or not available. Sage brush range or native weeds do not give nourishment enough and also do much to reduce profit and pleasure from the use of the milk, cream, or butter, and milk from cows on such pasturage is unfit for the manufacture of cheese. There is real demand, therefore for tame grasses to be sown for pasture alone.

There are many pasture grasses which succeed in the West, and some are more suitable for their localities than others. We have found none which produce a large amount of feed without irrigation or moisture conservation on our dry uplands. There are many places, however, where winter rye succeeds without irrigation. If planted early in September, winter rye will produce considerable winter and early spring pasture, and the early rains supply moisture enough to mature a crop of grain. Several of the native grasses, notably the Western Wheat-Grass, can be greatly increased in unirrigated meadows by seeding and harrowing. Under irrigation, even though there may be only water enough for winter flooding, or a single

(Continued on page 753)

Notes on Practical Irrigation

D. H. Anderson

Preparation of Soil for Planting.

One great object of cultivating or tilling the soil is to break up and loosen the earth, in order that the air may have free access to the dead vegetable matter in it, as well as to the living roots which spread and descend to considerable depth beneath its surface.

If it be desirable to have a luxuriant vegetation upon a given field of land, that is, a good crop, one must either select such kinds of seed as will grow in it, or which are fitted to the kind of soil in which they are planted, or change the nature of the soil so as to adapt it to the crop it is desirable to raise.

It is not denied that plants will grow in any soil that contains the general elements essential to their existence, but when the quantity and quality of the crop are considered as of importance, it is useless to "guess," for only partial satisfaction will result, and often entire failure, which is usually attributed to the elements or to the wrath of Providence.

Farming for profit means that the farmer knows every foot of his land and the nature of the soil; what it will grow and what it needs. A lack of this knowledge is farming for luck, and is equivalent to gambling with the eyes shut. There is less labor and twice the profit in harvesting forty bushels of wheat on an acre of properly cultivated soil than forty bushels on two acres roughly tilled. The case is the same with any sort of crop, and this is so plain that it seems absurd to mention it, yet it is forgotten in numerous cases of farmers, who go more on quantity of acreage than perfection of cultivation and increase of crop. It is not extensive farming that pays so well as concentrated farming. A man with one hundred acres well in hand is better off than another with five hundred acres of struggling crops. Wholesaling in any business is more expensive and the returns less than in retailing, and every farmer knows perhaps by bitter experience that everything about a farm it attended with expense, if not always in cash money, then in a draft upon his future strength and vitality. Irrigation, however, promises to be a cure for rambling farming, by compelling concentration. Why spread water over one hundred acres to raise a sparse crop when the same or much less water will secure a fine, luxuriant crop on twenty-five acres? When a single grain of wheat may be made to stool out into sixty plants, is it not better than when it stools out into only twenty? The former shows health, vigor, and productiveness, the latter mediocrity. The one means a syndicate, the other a home.

Soil is the Foundation.

The new beginner, the small farmer, reads accounts of the great farming schemes, the thousands and thousands of acres which run bank accounts into five and six figures. He dreams of gang plows, steam plows, combined harvesters and reapers, his fat cattle upon a thousand hills, and he swells himself up like the toad in the fable to equal the ox, and bursts in his effort. Let the reader desirous of gaining a competency through farming, acquire a home before he is worn out in the struggle, before his patient wife sinks beneath the sod in the effort, and his children grow up into cowboys, rustlers and desperadoes, imitate nobody, read none of the glowing accounts of successful great farmers without at the same time understanding that all such began, as a rule, on enormous capital, took a magnificent ranch through the early demise of a worn-out ancestor, through a mortgage foreclosure of some "imitator," or raises himself to grandeur upon the cheap labor of his fellowmen. Let him take the soil and treat it as the foundation for a home, for plenty, and the other things will come to him.

It was said in a former chapter that plants are like animals, in that to grow to perfection they must be properly managed and fed. A half-starved hog produces poor bacon, a chaff-fed horse has little energy, the wool of a starveling sheep is coarse and wiry, and even a human being, limited in his diet or restricted in nourishment, possesses a flabby, shriveled brain and a weak physical energy. Men say of animals: prune, cultivate, select, feed; of men, prune, cultivate, feed, and wherefore not say the same of plants and the soil: prune, cultivate, feed? Herein is the whole science of preparing the soil for cultivation, the heredity of plants, their atavism, their environments, the survival of the fittest, and whatever else may be said of animals and humanity. But to return to the great vegetable kingdom.

All of our practical writers agree, and the every-day farmer knows by his personal experience, that as the systems of roots, branches and leaves are very different in different vegetables, so they flourish most in different soils. The plants which have bulbous roots require a looser and a lighter soil than such as have fibrous roots, and the plants possessing only short fibrous radicles demand a firmer soil than such as have tap roots or extreme lateral roots. But it may be considered as a truism that shallow cultivation of the soil always produces minimum crops, whereas maximum harvests are gleaned by deep plowing whatever may be the plant.

It is always a question of the ability of the roots to reach out after food and their exposure to air. To comprehend this fully it should be considered that there is about as much of the plant under ground as above it, and the experienced farmer can always tell by the growth of his crop above ground whether the roots are doing well under ground, if the growth is not in accordance with the natural progress of the plant, there is some obstacle below the surface which can be removed by cultivation, the loosening up of the soil to a sufficient depth. How quickly growing corn revives and takes a new lease upon life after deep cultivation between the rows! Not shallow cultivating, or scratching over the surface, but "deep plowing." Level with a shallow cultivator afterward, of course, then hoe and see the stalks shoot up. It is some trouble, certainly, but do you not depend upon a good crop to make money, and to obtain a home? It is also a trouble to raise a child, but when it grows up straight, is not the labor more amply repaid than when it grows up crooked or stunted?

Cultivation Depends on Subsoil.

The character of the cultivation, however, depends upon the condition of the subsoil. Where that is hard or packed, it must be broken through, and up, to permit root penetration. Frequently, not to say generally, there is moisture beneath the hard, packed subsoil, and by breaking through the moisture finds its way up and "slakes" the hard pan or other resistant subsoil. There is also a difference in cultivation between the soils of the arid and the humid regions, differences which are atmospheric and also in the quantity of the organic elements which will be made apparent as we go along.

It seems unnecessary to repeat so simple a thing when it should be as plain as day, that plants possess an instinct that does not fall far short of the marvelous. For instance, in the arid regions the plant sends its roots down deep and out in every direction after the moisture which it apparently knows it can not get at the surface or near it, whereas, in the humid regions, the roots spread out more, because they apparently know that the moisture is near the surface and they do not have to toil so hard to make their way down deep. Anyone practicing surface irrigation will know that the roots of plants which have a habit of penetrating deep into the soil, grow along the surface, because the moisture is there. Plants always adopt the easiest method of obtaining food.

Now why do plants travel after moisture and not after dry soil? It is not water plants need, nor is it moisture, but it is food. They know that there is food material in the dry soils, but it is not in a fit condition to be absorbed, whereas, moisture prepares the food for them, hence they refrain from pursuing the raw material and expend their energies in seeking the manufactued product. Let a garden patch which has been kept moist, and in which the roots congregate, be allowed to dry, and another patch that has been dry and away from which the roots turn, be moistened, and the plants will grow away from their former hunting ground and in the direction of the new one. This is common observation. A beet root has been known to travel sixteen feet in the direction of a well where it knew it could get a drink, although plants, as a rule, are not drinkers but feeders of the most pronounced Epicurean type.

Deep Roots in Arid Regions.

In the arid and semi-arid regions it is better to provide for a deep burrowing of the roots, because when they fre-

quent the surface, they are liable to suffer from drought, or surface dryness. In this the reader will find an argument in favor of sub-irrigation.

Upon this instict of roots to seek their proper food in moist soil, depends the measurement of soil tillage, whether deep or shallow, and by "shallow" is not meant a mere surface scratching, but a good wholesome upheaval of the soil from a depth of eight to twelve inches, thence on up to eighteen if the subsoil be in question. Where the subsoil is not hard packed, then as deep as the subsoil; if packed it should be broken up. But where the subsoil is open and porous there is less need of deep plowing; on the contrary, it may be necessary to pack the bottom of the furrow, which is accomplished by a plow attachment known as a "packer," so arranged as to follow the plow and press down the earth at the bottom of the furrow; a useful contrivance where irrigation is practiced, inasmuch as it tends to prevent the leaching of the irrigation water down into the porous subsoil, where the water is run into the furrows.

It can not be too strongly impressed upon the reader that the soil must be so cultivated that it will retain moisture without permitting it to leach beyond the reach of the roots, and at the same time so broken up and pulverized that the roots may easily penetrate. Let this be the axiom constantly in mind: Give the plant roots room to spread. Upon this depends the perfection of the plant. "Stunts" are always caused by too little root room, the plant languishing because they are unable to reach moisture by reason of obstacles in the soil. If there is any moisture in the soil the plant will get it if it be given an opportunity.

Let us assume that we have a parcel of land in which it is purposed to grow plants without the application of manure. It does not matter whether it be virgin soil or one that has already grown a crop of any kind; the first thing to be done to this land is to improve the soil, that is, prepare it for vegetation. This may be done in seven ways:

First—By cultivation, or, more properly speaking, pulverization of the soil, by plowing and other mechanical means of reducing its consistency.

Second—By mechanical consolidation.

Third—By exposure to the atmosphere; that is, "fallowing."

Fourth—By alteration of its constituent parts.

Fifth—By changing its condition in respect to water.

Sixth—By changing its position in respect to atmospheric influences.

Seventh—By a change in the kinds of plants cultivated, or "rotation of crops."

Plowing and Pulverizing.

All these different methods of preparing the soil means practically the same thing—the breaking up of the soil, which must be done constantly if a good crop in quantity and quality be desirable.

By reason of their chemical elements the tendency of all soils is to concrete; that is, to run together in a sort of more or less hard cement, a tendency enhanced by the growing of crops and the application of water, or either. Thus, sand without consistency and quicklime without coherence, when mixed together with water, produce a hard cement or plaster, which may be crushed and pulverized before it can become again manageable. In soil the chemical agencies of nature are constantly at work to produce the same result; hence cultivation to break up, a tendency which is adverse to the growth of plants and free root penetration.

The very first objection of cultivation is to give scope to the roots of plants to spread in every direction, for without abundance of roots no plant can become vigorous, whatever may be the richness of the soil in which it is placed. The quantity of food taken from the soil does not depend alone upon the quantity in the soil, but on the number of absorbing root fibres. The more the soil is pulverized the more the fibres are increased, the more food is obtained, and the more vigorous the plant becomes. Any house plant growing in an earthenware pot will demonstrate this. The roots grown down and then, finding an obstruction, begin growing round and round in search of food, until the entire pot is filled with root fibres, even forcing out the soil to find room, and when they have grown to the limit of their confined space, the plant stops growing and becomes sickly.

Stirring Soil is Beneficial.

This cultivation or stirring up of the soil for root expansion is not only essentially precious to plant, or sowing, but highly beneficial afterward, during the progress of vegetation; and when practiced in the spaces between the plants it also operates as a method of root-pruning, by which the extended fibres are cut off, or shortened, thereby causing them to throw out numerous other fibres whereby the mouths or pores of the plants are greatly increased, and their food capacity enhanced. It is very much like fattening animals for market by encouraging their consumption of fattening food.

Cultivation renders capillary attraction more uniform, this peculiarity of the soil being greater when the particles of earth are finely divided. Thus, gravels and sands scarcely retain water at all, while clays, not opened by pulverization or other means of breaking them up, either do not readily absorb water, or when exposed to long action, they retain too much of it. In the arid regions deep cultivation is essential to admit moisture from the atmosphere, as for example, the dews of night. In irrigated sections deep and thorough cultivation checks evaporation and reduces the accumulation of alkali salts to a minimum, besides saving water.

Heat is tempered by deep cultivation, which is a great desideratum in the arid and semi-arid regions, the layer of pulverized soil serving the purpose of shade or mulch, and the evaporation retarded, the moisture acquires a uniform temperature. This seems to be a small matter in plant growth, but practical experience has demonstrated that it is an important part of the general combination of practices which result in successful agriculture.

Whenever the soil is opened, turned over and otherwise prepared for planting, a portion of the atmospheric air is buried in the soil and this air so confined, is decomposed by the moisture retained in the earthy matters. Ammonia is formed by the union of the hydrogen of the water with the nitrogen of the atmosphere, and nitre by the union of oxygen and nitrogen. So, also, the oxygen of the air may unite with the carbon contained in the soil and from carbonic acid gas. Heat is given out during all these chemical processes. As a rule farmers do not pay much attention to these simple facts, but the plants he is growing do, and they are more or less benefited as they are permitted to take advantage of these laws of nature, or prevented.

The depth of cultivation must depend upon the nature of the soil and the variety of plant grown in it. The subsoil, also, is not to be disregarded. Rich clayey soils can hardly be cultivated too deep, and even in sands, unless the subsoil contains alkali in dangerous quantities, or other plant poisons, deep cultivation should be practiced. When the roots are deep they are less liable to be injured by excessive water or drought; the radicals are shot forth in every part of the soil, the space from which nourishment is to be drawn being extended over a much greater extent than when the seed is superficially inserted in the soil.

Soil Must be Thoroughly Mixed.

In this respect cultivation should be attended with a thorough mixture of the soil by turning it over and over. Plowing, of course, accomplishes this result in a great measure, but the difference of gravity between the organic and the inorganic matters in the earth, has a tendency to separate them, for which reason light or shallow stirring of the soil is of little or no use practically, because it leaves the surface of the soil too light and spongy and the lower part too compact and earthy. Even where the plant roots are near the surface cultivation with a plow and a complete turning over of the soil is much better than the mere scratching of the surface, for there, as has been said, it is equivalent to root pruning.

In a former chapter reference is made to the fact that plant roots consume all the food in their neighborhood, and this furnishes another obvious reason for deep cultivation, otherwise the roots of a new crop reaching out for nourishment find an empty cupboard.

Some soils, however, require the opposite of pulverization and demand mechanical consolidation. This will be understood in the case of spongy peats and light, dusty sands. A proper degree of adhesiveness is best given loose soils by the addition of earthly matters in which they are deficient, perhaps th bringing up of a heavier and more consistent subsoil will accomplish the purpose. Rolling and treading, however, are simple methods, but in that case the soil must be dry, and the operation must not be carried too far, or so far as to concrete the earth, which is its constant tendency, as has been observed.

A peat bog drained and rolled will sooner become covered with grass than one equally well drained but left to itself. Drifting sands, however, may well be rolled when wet, and

by repeating the process after rains or floodings, they will in time acquire a surface of grass or herbage. Light soils should always be rolled, and the seeds should be "tread in" when planted, a pat with the hoe not being sufficient, as in the case of heavier soils, unless the seeds be very small.

Weather Affects Soil.

Exposure to the atmosphere, speaking with reference to soils, means "lying fallow," the only benefit of which, and sometimes it is not a small one, is to expose insects and their eggs, weeds and their seeds, to destruction. In climates where there are severe winters and hard frosts, a hard, lumpy soil becomes pulverized by the action of the frost, and soils that have become soured, sodden and baked by the tread of cattle or other cause in wet weather, are more rapidly sweetened and restored to friability by exposure to the hot sun of summer, than by the frosts of winter. Some maintain that the only benefit of fallow, that is, turning up the soil roughly to the atmosphere, is to free the soil from the roots of weeds. There is nothing, indeed, in the idea that the land "needs a rest," for if properly cultivated, soil will keep on producing as long as there are any elements capable of feeding plants. The idea originated in ancient times when lack of help to till the entire farm, or a deficient supply of manure, compelled the suspension of cultivation on certain parcels or fields. It is certain that what is called an "exhausted soil" obtains no renewing material from the atmosphere.

To alter a soil is to add or subtract the ingredients which are lacking, or which exist in excess. The so-called "alkali soils" are an illustration of excessive ingredients, and any sterile, sandy or gravelly soil may be regarded as one representing a deficiency of food producing elements. In case of sterility, the only remedy is to add the ingredients lacking, or convert sterile material into fertile ones by chemical means. Thus: where in sterile soil, on washing it, there is found the salts or iron or acid matters, the application of quicklime will ameliorate it, and in a soil of apparently good texture, but sterile on account of the sulphate of iron, a top dressing of lime will afford a remedy by converting the sulphate into a manure.

If there be an excess of calcareous matter in the soil it may be remedied by the application of sand or clay. Too much sand is improved by clay, marl, or vegetable matter, and light sands are benefited by a dressing of peats, and peats improved by adding sand. The labor of thus improving the texture or constitution of the soil is more than repaid by the requirement of less manure, in fact, accretions in the way of new soil are a natural manuring and insure the fertility of the soil, where manure might be doubtful on account of its adding an excess of organic matter, which is equally as deleterious to plant growth as too much inorganic matter. An equal number of tons of sand, clay, marl, or other natural soil, as of manure, will often tend to greater productiveness than from the addition of manure. When there is an excess or superabundance of soil material, the problem of its removal is much more difficult and serious, the reclamation of alkali lands abundantly demonstrating this. Ordinary sand and gravel may be plowed under, scraped from the surface, or partly washed off by flooding, particularly where the lay of the land is sloping. In the case of alkali, as has already been said, drainage, or exhaustion of the soil by the cultivation of gross feeding plants seems to be the reasonable remedy; at all events is proves effectual.

Effect of Fire on Soil.

Burning over the soil was an ancient method, one used by the Romans to alter the constituents of the soil, the object being to render the soil less compact, less tenacious, and less retentive of moisture by destroying the elements that tend toward holding it in a concrete consistency.

It is practiced in the United States for the same purpose, but in the vast areas of the boundless West, where a man is not limited to a small acreage of the soil, it is not regarded as worth the labor, although it might in many instances be beneficial. The soils improved by burning are all such as contain too much dead vegetable fiber, by the burning of which they lose from one-third to one-half of their weight. So stiff clays, adobes, hardpans, and marls are improved by burning. But in the case of coarse sands, or where the elements of the soil are properly balanced, burning is detrimental, and the same is the case in silicious sandy soils after they have once been brought into cultivation.

As to changing the condition of lands in respect to water, the subject belongs to irrigation, but it may be said here in passing, the land should be cultivated, having in mind the flowing of water, whether from irrigation or rain, so as to avoid the accumulation of stagnant water, which is injurious to all classes of useful plants. When the surface soil is properly constituted and rests on a subsoil moderately porous, both will hold water by capillary attraction, and what is not so retained will sink into the substrata by its gravity; but when the subsoil is retentive, it will resist the percolation of water to the strata below and thus accumulate in the surface soil, and, making the latter "soggy," will cause disease to the plants. Hence the origin of surface draining, that is, laying land in ridges or beds, or intersecting it with small, open gutters, a very good practice where irrigating water is used, for into them the water may be turned and then plowed over, left to come up to the surface where the plant roots can reach it. The alteration of land by water will be treated in detail in its proper place under the head of "Irrigation."

Value in Ridging Land.

We have already referred to the effect of the sun's rays on land, and add here that in cultivating, there is one advantage in ridging lands and making the ridges run north and south, for on such surfaces the rays of the morning sun will take effect sooner on the east side, and those of the afternoon on the west side, while at mid-day the sun's elevation will compensate for the obliquity of its rays to both sides of the ridge. In gardening there is much advantage in observing this method of cultivation, for the reason that much earlier crops may be produced than on a level ground. Thus, sloping beds for winter crops may be made southeast and northwest, with their slope to the south, at an angle of forty degrees, and as steep on the north side as the mass of earth can be got to stand. On the south slope of such ground of course the crops will be earlier than on level ground. There is little advantage of this sloping, however, unless perfection of garden produce is desirable, although the advantage of sloping is a diminution of evaporation and also a ready natural drainage.

Although rotation of crops will be treated in a special article, the subject has a bearing upon cultivation, or treatment of the soil, since the necessity for a rotation of crops seems to grow out of a diminution of certain plant foods desirable to certain plants, and there are many species of plants which require particular substances to bring their seeds or fruits to perfection. It may be that these particular substances are in the soil but beyond the reach of the plant. In that case it is clear that a thorough mixing of the elements of the soil will bring the appropriate food within reach of the plant, or, if that cannot be done, then the planting of some other crop, and permitting it to return back into the soil, will afford the required food for the desired plant. In this place, cultivation and thorough mixing is advised. In the proper chapter the whole subject will be treated in detail.

The following are some of the root and soil peculiarities of well known plants:

Wheat—Has feeble roots at surface, but strong tap roots penetrating deep into the soil. Stiff soil.

Oats—Next to wheat, will stand stiff soil, but the plant throws out in the superficial layer of soil a number of fine feeders in lateral directions, and hence the top soil should be light and open.

Barley—It throws out a network of fine, short root fibers of no great depth and requires a light, open loam.

Peas—Requires a loose soil, with little cohesion, and spread soft root fibers deep.

Beans—Ramify strong, woody roots in all directions, even in a heavy and compact soil.

Clover—Grass seeds and small seeds generally put forth at first feeble roots of small extent, and require so much the greater care in preparing the soil to insure their healthy growth. The pressure of a layer of earth a half to one inch thick suffices to prevent germination. Such seeds require only just as much earth to cover them as will retain the needful moisture for germination.

It is on the root that the farmer should bestow his whole care. Over that which grows from it he has no control, except perhaps in the way of pruning or bud "pinching," as in the case of tobacco, melons, fruits, etc.

Supreme Court Decisions

Irrigation Cases

Expert Testimony—

Expert knowledge is not necessary to testify whether a crop of rice was sufficiently watered to make it properly grow. —*Kincheloe Irrigating Co.* v. *Hahn Bros. & Co.* Court of Civil Appeals of Texas. 132 Southwestern 78.

Reclamation Districts—

A petition for organization of a reclamation district sufficiently described the land where it referred to a well-known ranch and to a map, though the latter is not shown to have been recorded.—*Metcalfe, County Treasurer,* v. *Merritt.* Court of Appeal, Second District, California. 111 Pacific 505.

Change in Point of Diversion—

The right to change the point of diversion of an irrigation ditch, connected with a natural stream, though a property right, is not absolute, and will not be permitted if it affects vested rights of others.—*New Cache La Poudre Irrigating Co.* v. *Water Supply & Storage Co.* Supreme Court of Colorado. 111 Pacific 610.

Change in Point of Diversion—

A decree permitting a change in the point of diversion of an irrigation ditch does not, and cannot, entitle the recipient to divert more water than he theretofore took, nor to use it for longer than he was previously entitled to.—*New Cache La Poudre Irrigating Co.* v. *Water Supply & Storage Co.* Supreme Court of Colorado. 111 Pacific 610.

Reclamation Bonds—

One who successfully bids for reclamation district bonds on condition that they be legal and valid can question any proceeding which was so defective as to invalidate the bonds, but cannot attack the validity of the organization of the district if the district had a *de facto* existence when it issued the bonds.—*Metcalfe, County Treasurer,* v. *Merritt.* Court of Appeal, Second District, California. 111 Pacific 505.

Competency of Expert—

It may be presumed that an employe of defendant irrigation company in charge of the distribution of water for irrigation had sufficient knowledge to know whether rice land was obtaining sufficient water, and defendant shoulo not attack his competency to so testify. *Kincheloe Irrigating Co.* v. *Hahn Bros. & Co.* Court of Civil Appeals of Texas. 132 Southwestern 78.

Determination of Amount of Water—

The amount of water in inches to which a riparian owner may be entitled for irrigation as against other riparian owners is impossible of estimation, varying continually, not only by the varying volume of water flowing down the stream at different times of the year, or at different years, but also from the amount of land that may have been settled upon, and the extent of the use of the water for ordinary or natural purposes.—*Lone Tree Ditch Co.* v. *Cyclone Ditch Co.* Supreme Court of South Dakota. 128 Northwestern 596.

Water Rights in Interstate Stream—

The Federal Circuit Court for the District of Nevada and the California state courts have concurrent jurisdiction to determine the relative rights of parties claiming, the one in Nevada and the other in California, to be entitled to appropriate, as against each other, the waters of an interstate stream, and whichever court first acquires jurisdiction is entitled to proceed to final determination without interference from the other.—*Richey Land & Cattle Co. Petitioner,* v. *Miller & Lux.* Supreme Court of the United States. 31 Sup. Ct. Rep. 11.

Use of Riparian Rights—

A riparian proprietor's right to use the water of a stream is an incident of ownership of the riparian lands, which can be lost only by adverse prescriptive right, grant, or actual abandonment, and does not depend on use, so that, where a riparian proprietor's settlement antedated plaintiff's appropriation, it was not material to the riparian proprietor's priority that he did not use the water for irrigation on his land prior to such appropriation.—*Redwater Land & Canal Co.* v. *Reed.* Supreme Court of South Dakota. 128 Northwestern 702.

Failure to Furnish Water—

In an action for damages for the breach of a contract to supply water for irrigating the plaintiff's lands, where it appears that the land is unbroken and practically unproductive prairie, if the plaintiff prevails he can only recover the difference between the rental value of said land with water according to the terms of the contract and the rental value without such water. The supposed value of what the land might have produced had the water been furnished is too remote, speculative, and conjectural.—*Wade* v. *Belmont Irrigating Canal & Water Power Co.* Supreme Court of Nebraska. 128 Northwestern 514.

Nature of Use—

As between riparian proprietors using the water of a stream for domestic purposes and for watering stock, the owner whose land lies nearest the source of the stream may use all of the water, if he needs it, to the exclusion of the others; but, with reference to an artificial use including mining, manufacturing, and irrigation, there is no preference as between riparian owners owing to the location of their land, the rights of all being exactly the same, and limited to a reasonable use in view of the rights of all the other riparian owners on the stream.—*Lone Tree Ditch Co.* v. *Cyclone Ditch Co.* Supreme Court of South Dakota. 128 Northwestern 596.

Point of Diversion—

Civ. Code, Sec. 278, declares that the owner of land may use water running in a definite stream formed by nature over or under the surface as long as it remains there, but he may not prevent the natural flow of the stream, nor of the natural spring from which it commences, in its definite course, nor pursue nor pollute the same. *Held,* that a riparian proprietor, under such section, which was declaratory only of the common law, desiring to use the waters for irrigation, was not bound to divert the water at a point within the boundaries of his own land, but was entitled as against lower riparian proprietors to divert the water on the land of upper proprietors with their consent, so long as the quantity of water taken does not exceed the amount defendants are entitled to use.—*Redwater Land & Canal Co.* v. *Reed.* Supreme Court of South Dakota. 128 Northwestern 702.

"Mutual Irrigation Company"—

An irrigation company organized under the laws of this state, which has no source of income, derives no revenue from the operation of its ditch or canal, and conducts its business solely for the purpose of irrigating the lands of its members and stockholders, is, *de facto,* a "mutual irrigation company" as defined by Section 6845, Cobbey's Ann. St. 1909. Such a company may adopt by-laws regulating the use of the water it has appropriated, by its stockholders in turn, and require each of them to contribute his proportionate share to a maintenance fund to enable it to carry on the enterprise, and may make the payment of the same a condition of the right of the stockholder to receive water to irrigate his land; and, where such by-laws are agreed to and signed by all of the stockholders of the corporation, the courts will recognize and enforce the same as a valid contract binding alike upon all of them.—*Omaha Law Library Ass'n* v. *Connell,* 55 Neb. 396. 75 N. W. 837. *Swanger* v. *Porter,* Supreme Court of Nebraska. 128 Northwestern 516.

Adverse User.

A river divided into two channels, K. and S., between which a natural channel, opening into K., existed. An artificial channel was dug connecting S. with the natural channel, and by means thereof, the waters of S. were diverted to K. for use below the mouth of the natural channel. The person who so used the waters owned the ditches connecting with K., together with the water rights belonging thereto. *Held,* that the right to the use of the water flowing through the natural channel into K. was an appurtenance to the ditches, and the water right followed the ownership of the ditches.—*Evans Ditch Co.* v. *Lakeside Ditch Co.* Court of Appeal, Third District, California. 108 Pacific 1027.

(Continued from page 748.)

irrigation in the summer season, the number of pasture grasses from which to choose is much larger. In mountain meadows, or where there is abundance of water, timothy, redtop, Kentucky bluegrass, and orchard grass all find a place. In many parts of the West, Alsike clover and sainfoin or French clover do well, and they are said not to be dangerous to stock from causing bloat. Brome grass is proving of great value.

Grass Mixtures.

As a rule, if land is to be seceded down to pasture. a mixture of suitable grasses will give better results than planting a single variety. Where a moderate amount of irrigation can be given the land, we suggest a mixture of Slender Wheat-Grass, six pounds; Tall Meadow Fescue, six pounds; Brome-Grass, the Awnless Brome-Grass, or the Western Brome-Grass, six pounds; Kentucky bluegrass, four pounds; and to this may be added of Sand or Hairy Vetch, eight pounds. This makes a total of thirty pounds of seed per acre, and we suggest trying the Vetch on a part of the land until its merit may be tested. An irrigated meadow planted to these grasses may become sod-bound after a few years, but this can be avoided by properly discing or harrowing the sod.

There are few western ranches where the facilities for weighing hay are present or convenient. On our larger ranches where wagon scales have been purchased, the owners seldom go to the trouble of weighing the hay which they sell from the stack. It is probable that the usual method of measuring hay seldom gives accurate results. In the first place, the measurement itself is only an estimate of the number of cubic feet of hay in the mow or stack; in the second place, the number of cubic feet of hay which is required to weigh a ton varies greatly. It a mow is full of hay, it may be squared up. Simply multiply the height by the width, and this by the length, which will give the total number of cubic feet. Stacks in the field, however, have no square sides or peaked top. There are five methods in general use for measuring stacks:

First, the one known to most farmers is to measure the distance over the stack by throwing a rope or a tape over from one side to the other, letting it come to the ground. To this distance add the width of the stack, in feet; divide by four to get the square of the end of the stack; square this number to get the square feet, and multiply by the length to determine the total number of cubic feet.

Second, take one-third of the over and multiply by the width for the end surface, and multiply this result by the length.

Third, subtract the width from the distance over; divide by two for the height; multiply this by the width, and this product by the length.

Fourth, multiply the width of the stack by the distance over, and this product by the length and divide by four. This method has been found to give results too small, sometimes as much as thirty per cent.

The formula worked out by the Bureau of Plant Industry of the U. S. Department of Agriculture is given as follows:

$0.225 (O-W) OWL \div H$. O is the distance over the stack; W is the width; L the length, and H the height. First, subtract the width from the distance over; then multiply by the distance over; this by the width, and this product by the length, and this whole product by the fraction 0.225, and divide the result by the height of the stack. All the measurements must be in feet and fractions of a foot. Working out the problem in this way gives the total number of cubic feet in the stack.

It is claimed that this rule gives results with not more than from two to four percent error. The number of cubic feet making a ton of hay is divided into the total number of cubic feet in the stack to determine the number of tons.

The cubic feet of hay making a ton will vary with the amount of time the hay has settled, with the kind of hay, with the amount of moisture it contains, with the weather and various other factors. It is generally conceded that 500 cubic feet of well pressed timothy hay is required to make a ton.

Reclamation Notes

MISCELLANEOUS.

Farmers in Reno and Stafford counties, Western Kansas, are interested in experiments conducted by S. Askew near Maxville. At a depth of fourteen feet he struck water which rose within a few inches of the surface. This section has suffered from drought and it is believed that other farmers will adopt the pumping system for irrigating their crops.

Fruit growers near Pawpaw, Mich., are planning a comprehensive irrigation system. A supply of water will be secured by pumping. This section of the state has suffered from drought and it is believed that an irrigation system will increase prices on farm lands.

The statement is made at the office of the Texas State Agricultural Board that prospect for irrigating large tracts of land in the Pan Handle counties of Oklahoma by artesian wells seems encouraging. It is believed that this district can adopt plans similar to those in use at Garden City, Kan. Preliminary experiments are said to have been satisfactory.

Plans are developing for an immense Irrigation project on the Medina River about eight miles from Castroville, in Texas. San Antonio and eastern men are said to have ordered surveys for a system to water 20,000 acres. It is planned to build a dam across the Medina River to catch flood water.

Landowners in the vicinity of Del Rio, Tex., are said to be interesting themselves in pumping from underflow. Reports of geologists and experts on the available supply are said to be satisfactory. All practical experiments thus far conducted have been successful.

Irrigation by pumping is receiving attention at Tulia, Swisher County, Texas. A test well was sunk on the farm of J. C. Fry and water was found at sixty feet. The well will be sunk lower.

The Leon Springs Irrigation Company of Phoenix, Ariz., capital stock $40,000, has been authorized to do business in Texas. Headquarters will be established in Dallas.

CALIFORNIA.

The Warmoth-Kreling Company has filed on 100,000 inches of the flood waters of Thomas Creek in Tehama County. Water is to be conveyed to a reservoir in Glen County, where it will be used for irrigation purposes.

Reports during December stated that the Sacramento Valley Irrigating Company had discontinued work on its system near Maxwell. This report is now denied, and it is stated that the Sacramento Company will proceed with construction work without interruption.

The ancient suit of the North Fork Water Company against the Bear Valley Irrigation Company is being tried in the United States District Court at Los Angeles. The original complaint was filed in 1899. The plaintiffs allege damages on account of lack of the defendant to furnish certain water under contract.

Reports from Frenso, dated December 15, stated that suits were being tried in the case of Laguna Reclamation District No. 799 against William M. Atkinson and three other land owners. The suits were started in March, 1909, and involved the legality of a $40,000 district assessment. The organization of the district is also attacked on legal grounds.

Capitalized at $2,000,000, the Tehama Land and Irrigation Company has recently filed articles of incorporation at Red Bluff. The principal places of business are Phoenix, Ariz., and San Francisco. Directors and principal stockholders are: Guy C. Calven, W. H. Underwood, William P. Snyder, F. A. Smith & Co. and C. E. Todd. Facts concerning the projected operations of the company over the land to be reclaimed are not given.

The initial steps toward forming an immense irrigation district have been taken by owners on the west side of Stockton. It is estimated that there will be 1,500,000 acres included in this district and that the cost of the

projected construction work will reach $6,000,000. Water will be taken from the San Joaquin River and carried through canals about eighty feet above the level of the stream. The Miller-Lux interest, at present owning a private irrigation system, may be included.

The following trustees were elected for the new reclamation district in the vicinity of Wheatland, Yuba County: F. M. Hollingshead, R. Russell, R. H. Dursk. The preliminary organization was formed about three months ago.

Reports from Hanford state that James Newland, of San Francisco, and J. Minturn and G. W. Goodfellow, of Fresno, have purchased about 4,000 acres on the west side of Tulare Lake. Formerly it belonged to the Tulare West Side Company and D. S. Kohn. Part of the land is submerged and it is proposed to construct an extensive system of levees.

New York capitalists are said to have recently purchased about 65,000 acres of land in Southern Tehama and North Glen counties. A reservoir will be constructed in the basin of Dry or Little Stony Creek. Surveys for the dam and main canals were completed early in December. About $800,000 will be expended for the reclamation of 16,000 acres and it is estimated that nearly 140,000 acres are available for irrigation in the same district. The new company will use the filing of L. W. Warmboth, of Paskenta in Thoms Creek.

Reports from San Bernardino state that a company is planning the reclamation of 1,000 acres near the New York Mountain. Experiments with artesian wells show that a copious flow of water can be obtained at 250 feet.

The following dispatch from Willows appeared in the Oakland Inquirer: "The Sacramento Valley Irrigation Company has ceased work on the development of the Delevan and Maxwell units of its 250,000-acre irrigation and colony project, following the constant litigation over the right-of-way for its main canals. The large Chambers tract adjoining Hamilton City, consisting of over 1b,000 acres, which was recently purchased, seems to be now the basis for further development. Large surveying parties are located there and are actively at work with a view to letting the contracts for construction early in the spring. As this large acreage adjoining is in a solid body, it means all work can be carried on without the annoyance of unnecessary litigation over the rights-of-way. This unit is to be known as the Hamilton unit."

At the annual meeting of the Paradise Fruit Growers' Union in Butte County a resolution was adopted approving the plan for a complete irrigation system for Paradise, authorizing the president of the union to appoint a committee of three to investigate the feasibility of the project for report in about ninety days. J. H. Kimball, C. M. Burkett and James Pearson are members of this committee.

Engineer Edwin Duryea, Jr., of the South San Joaquin Irrigation District, is making surveys for the construction of a system to water 70,000 acres in San Joaquin. Supply of water will be taken from the Stanislaus River, five miles above Knight's Ferry, and by a series of tunnels will be brought to the vicinity of Eugene, where a reservoir site is proposed. The district has voted $1,375,000 in bonds for construction work. Eastern financiers are negotiating for the purchase.

Settlers in the Palo Verde Valley are said to favor an irrigation district and to be taking steps for its formation.

The directors of the Santa Ana Valley Irrigation Company have started a campaign for the passage of several needed changes in the constitution and by-laws of the organization. A committee consisting of A. N. Saxton and H. W. Saxton has been appointed to secure signatures from the stockholders to the proposed changes.

At a meeting of the stockholders of the Colusa Irrigation Company the following were elected as directors: President George C. Ahlf, John Mogk, C. Wescott, C. Johnson and J. R. Tenant. All those elected had been holding the same positions.

The Fontana Water Company has recently let contracts for portions of the Gravity Irrigation System to bring water from Lytle Creek. One of these contracts was for reinforced concrete main nad the other for ten miles of laterals of ten-inch cement pipes between the main line and San Bernardino avenue.

Land owners in the vicinity of Stockton and the city of Gustine are arranging to form an irrigation district with the aid of the Miller-Lux interest. Water will be taken from the San Joaquin in sufficient quantities to irrigate 1,500,000 acres.

At a recent meeting of directors of the Tipton Irrigation District steps were taken to settle the bonded indebtedness, thus clearing title to all land under this project. John Clark was elected president of the board and F. B. Hawkins secretary.

By the filing on 250,000 inches in Miner's Ravine by B. T. Marshall, rumors that the California Corporation is about to embark on a huge project near Auburn, Placer County, have been revived. Engineers of the company are reported to have made surveys of this section. It is proposed to construct a dam and reservoir for storage of water.

J. F. Herriger has recently filed on 25,000 inches of Feather River near Oroville, Butte County. Water is to be diverted a few miles below the city and will be carried through a ditch to land west of Palermo. He is reported to be working in the interests of a company now in process of formation.

Insufficiency of rain in the distdict near Woodland, Yolo County, has induced farmers to sink several experimental wells to discover a supply of water available by pumping. In the event that these experiments are successful it is probable that the entire beet-raising community will turn to this method of irrigation.

The Turlock Irrigation District, at an election on December 7, voted for the issuance of $1,260,000 in bonds for the construction of a reservoir and the enlargement of the irrigation canal.

The Fresno Valley Irrigation Company of Los Angeles has filed articles of incorporation showing capital stock of $6,000. Directors are: Emil Firth, M. M. Ritterbard, C. E. Davenport, Sidney Steenburg and H. M. Lindsey, all of Los Angeles. The corporation was formed to furnish facilities for irrigation in the Fresno Valley land tract.

COLORADO.

F. C. Thorton, a wealthy rancher of Wigwam, is promoting an irrigation project south of Wigwam for the enlargement and extension of the existing system to include about 35,000 additional acres. He estimates that the cost will reach $600,000. Water for the new acreage will be taken from the Fountain River and from Wigwam Creek. Two reservoirs will be constructed. Surveyors began work in October and have now finished plans and estimates.

The Pawnee Irrigation District, near Sterling, voted on a bond issue December 6. It is estimated that the cost of construction will aggregate $500,000. About 22,000 acres of land will be brought under water. This district was organized several months ago.

Many farmers in the vicinity of Gilcrest, profiting by the success in pumping water for irrigation, have arranged to secure their supply in this way. A large number plan to have wells in operation before the opening of the coming season.

The Riverside Land and Irrigation Company, operating in Delta County, has been investigated by the Department of the Interior and accused of selling lands by fraudulent use of the United States mails. Indictments were returned.

Among the directors elected by stockholders in irrigation districts during the past month are the following: Orchard Mesa Irrigation District, George W. Smith and O. G. Coen; East Palisade Irrigation District, A. B. Harris; South Palisade Heights Irrigation District, J. M. Woodall; Mesa County Irrigation District, R. H. Bancroft; Otero Irrigation District, Robert Edgerton.

The Henrylyn Irrigation District, at its annual meeting, re-elected Frank A. Hensley director for three years more. Work will begin on the contract for the completion of the system early this year.

The Mesa County Irrigation District has ordered an immense new centrifugal pump, to be used in supplying water to the 8,000 acres in that district.

Reports dated December 17 from Greeley stated that the Poudre Valley Irrigation District, of Weld County, was in process of formation. The election to vote at the organization will be held during January. If formed, this district will spend about $2,000,000 on the reclamation of 80,000 acres in the vicinity of Nunn, Dover, Carr and

Bulger. W. M. Morse, of Greeley, and E. S. Smith and W. Rollo Smith, of Denver, are associated with eastern capitalists.

State Engineer Comstock has recently made an inspection of the dam on the Beaver Land and Irrigation Company's project in Beaver Creek Canyon and has pronounced it satisfactory.

A meeting of stockholders in the Laramie-Poudre Irrigation District was called for January to vote on an adjustment of the district's affairs whereby the construction work might be finished. Work on this project was delayed on account of finances, the construction company being unable to secure sufficient funds by the sale of bonds. Through the new plan it is predicted that operations will be resumed in the spring.

According to statements of L. L. Stimpson, Chief Construction Engineer for the Great North Sterling Irrigation System, the project is now practically completed with the exception of Sedgwick reservoir in Sedgwick County. About 80,000 acres will be brought under water at the conclusion of this work.

Terms of the contract between the Bent-Prowers Irrigation District at Lamar and the Southwest Construction Company call for the reclamation of 80,000 acres. Bonds amounting to $400,000 will be issued. Specifications for work call for a dam across the Purgatoire. The contractor is to complete his work within three years.

The Hunter-Mesa Irrigation District at Rifle is said to have adopted the plan to procure water on Plateau Creek. After bringing the supply over the divide it will be carried through West Mann Creek to the 10,000 acres known as the Hunter-Mesa tract. Engineer Warring, of Grand Junction, has made surveys.

It is reported that officials of the High Line Canal near Grand Junction have arranged to begin construction work early in the present year. About $250,000 will be available.

The dam constructed by the Two Buttes Irrigation and Reservoir Company near Lamar has been completed and will store spring flood waters for summer use.

J. N. Gibbs & Son, of Trinidad, are said to have financed a plan for the expenditure of $10,000 to irrigate a tract of land in Sunflower near Hoehne.

The Blue Mountain Land and Irrigation Company has submitted plans to the State Board for the reclamation of a large tract of government and state land in Rio Blanco and Routt counties. James H. Clark, engineer, has pronounced the project to be feasible.

Maps and estimates for the Wild Horse reservoir and canal system have been filed with the County Clerk at Greeley. The company controls 12,650 acres in the northeastern part of the county and proposes to spend $25,000 on an irrigation system. Wild Horse Gulch will supply water.

IDAHO.

The Little Willow Irrigation Company has completed surveys and located several reservoir sites near Payette. It is reported that active construction work will be begun in the near future.

Contracts closed by the One Thousand Springs Company, represented by R. D. Roberts of Boise, call for the construction of an irrigation system to irrigate 4,000 acres on the Snake River below Medbury, also 4,000 acres adjacent to this tract. Work on these contracts will start early in 1911 and it is estimated that the cost will aggregate $50.00 per acre. Water will be taken from the Snake River below Brown's Flats and the company will use a portion of the electrical power for commercial purposes.

A. P. Davis, reclamation engineer, is reported to be authority for the statement that the government will construct a dam on the lower Boise, either at Arrow Rock or Hell Gate. He estimates that six years will be required for construction work and that the cost will aggregate $3,000,000. This dam, if constructed, will be the largest of its kind ever projected by the Reclamation Service.

Reports from Chicago papers state that the Big Lost River Irrigation Company has defaulted on interest of a bond issue of $1,355,000.

MONTANA.

Private capital is said to be backing H. R. Albion, an

expert engineer who is now making surveys for a reclamation project involving about 20,000 acres just across the line from South Dakota. It is proposed to take water from the Little Missouri Valley. Recent reports state that Albion's work is nearly finished and definite announcement of the firm backing his efforts will be made in the near future.

Reports from Washington, as published by Montana papers, state that the Milk River delegation and officers of the Reclamation Survey Service have reached an agreement regarding the adjudication of water rights and division of water for irrigation purposes. At last report the tentative plan had not been approved by Secretary Ballinger.

Andrew Sullivan, of Forsyth, has the contract for enlargements and extensions of the Big Yellow Stone Irrigation system at Sanders and Forsyth. The total cost of the contemplated improvements will aggregate $25,000.

The ditch will be twenty-nine miles in length, will water 14,000 acres and must be completed for use in 1912.

Horticulturists near Billings are interested in irrigation by pumping and it is claimed that about 12,000 acres of orchard land wll be recliamed by this method. The experiments in pumping, as conducted on smaller tracts, have been successful. It is claimed that if the larger project can be brought to a successful conclusion there will be many other plans outlined in the near future.

Reports from Chicago stated that the Conrad Land and Water Company had defaulted on its January bond interest and that foreclosure proceedings are in prospect. This company is capitalized at $1,000,000 and has issued bonds to the amount of $1,016,000. It is estimated that $500,000 is necessary to complete the system.

Commissioners of the Yellow Stone Irrigation district are said to have closed negotiations with the National Securities Company for the sale of district bonds amounting to $116,000. The proposed canal will water 15,000 acres lying in the Yellow Stone Valley between Sanders and Forsyth.

To discover the possible effects of seepage from the proposed irrigation canal now under construction in Granite County, E. Tappan Tanatt, President of the Jordan-Tanatt Engineering Company of Helena and Spokane, has recently finished exhaustive investigations. It is predicted that the result of these investigations will have an important bearing on the operations of irrigation companies in Montana.

NEW MEXICO.

Farmers owning property west and southwest of Deming are interested in irrigation by pumping. Numerous pumping plants are now being installed and it is claimed that large tracts of land will be irrigated in this way.

Incorporation papers have been filed by the Biggs Irrigation Company of Willard, Torrance County. Capitalization is $50,000. Incorporators and directors are S. V. Biggs, Frederick Biggs, W. W. Hubbard of Willard. It is proposed to install an electrical pumping system.

Santa Fe newspapers state that negotiations are pending between the French Irrigation Company, the Maxwell Irrigation Company and the Eagle's Nest Irrigation project of Colfax County, with a view to consolidation. George T. Nicholson of the Santa Fe System is said to be interested.

Reports from Santa Fe state that the Abreu-Raydo ranch, near Springer, consisting of 35,000 acres, has been sold to the Hagedorn Investment Company of Denver for $350,000. The new owners propose to colonize the land after an irrigation system has been constructed.

An irrigation company operating in Valencia County is forming the new town of Sais. The Irrigation Company has 20,000 acres of land, which it is proposed to irrigate by waters stored in the canyon near the new town.

J. C. Fields, a civil engineer from Denver, is in charge of the surveying work for the proposed Logan dam north of Tucumcari. The original survey embraces about 75,000 acres. Proper authority for the construction work has been secured from the commissioners of Quay County.

The Hagerman Irrigation Company of Hagerman is arranging to construct a cement block-head at its canal to control water from the Hondo. It will be about 140 feet in length and 17 feet high.

Reports from Carlsbad state that the Reclamation Service is making surveys for additional construction on the government project. The McMillan reservoir will be enlarged and the main canal repaired.

From Albuquerque it is reported that McBee and Hockenhull are prepared to reclaim 12,000 acres near Melrose by an electrical pumping system. It is proposed to have water ready for use for spring planting. Bonds will be issued. W. D. McBee of Clovis, a former member of the legislature, heads the new concern.

The American Sugar Refining Company of New York has made a proposition to farmers near Hagerman to install pumping plants on irrigated land and to locate a sugar factory near that point, providing farmers agree to plant a specified acreage to sugar beets. Farmers are said to look with favor upon this proposition.

OREGON.

It is announced by E. L. Thompson, president of Hartmen & Thompson, at Portland, that more than $1,000 in the stock of the syndicate formed for the development of Willamette Valley Irrigation project has been subscribed. It is the purpose of this company to take up options on tracts covering a total of about 25,000 acres. Scientific tests will be conducted to determine what irrigation method shall be adopted. It is probable that a comprehensive system for storage of water will be outlined. The syndicate is authorized by its charter to extend its operations to other points.

Charles Horton, retired capitalist of Seattle, has purchased a large tract of land in Yonna Valley near Bonanza and proposes the construction of an irrigation system. Buck Creek Canyon will be utilized as a reservoir by the construction of a dam. He has already fully outlined his plans for construction work.

Flood waters in Willow Creek near the upper end of Langell Valley forced out the dam of a private irrigation project on December 7. Construction work had been nearly completed and considerable work on canals and laterals had been begun. It was proposed to supply water to about 4,000 acres. Later reports indicate that the dam will be rebuilt.

All bids received by the Reclamation Department for furnishing a skid dredge for the Klamath Irrigation project were rejected, the project engineer regarding them as excessive.

Senator Abner Weed, of Siskiwon County, is constructing an irrigation system to supply water to 20,000 acres of land on the Wood River near the Klamath Indian Reservation, in the northern part of the county.

Surveyors working in the interest of John C. White, of Pittsburgh, are making plans for an irrigation ditch forty-two miles in length, to supply water to 20,000 acres in the upper South Umpqua and Cow Creek valleys, Douglas County. It is planned to build and maintain an irrigation system under the Municipal District Law, which allows land owners to vote bonds for construction purposes. The cost of the system is estimated at $800,000.

Dispatches in newspapers at Klamath Falls announce that the Indian appropriation bill, reported to the United States Senate, has an amendment passed by the Indian Committee providing $50,000 for construction of the Modock Point Irrigation project on the Klamath Indian Reservation. The maximum of $185,000 necessary to complete this project must come from the sale of timber on the Indian reservation. The land to be watered lies north of Modock Point.

W. C. Parish, superintendent for the East Oregon Light and Power Company at Baker, has recently returned from Burns and Harney counties, where he has been making investigations regarding an irrigation project. He proposes to establish pumping plants to be operated by electricity and to take water from the Silvies River. Land owners in Harney County are said to favor the plan. There is prospect that early spring will bring opening operations.

By authority of Judge Calkins, Receiver Wharton, of the Golden Drift Mining Company, is empowered to issue certificates to cover cost of repairing work on the Ament dam, near Grant's Pass. Much of the work and considerable machinery was washed away by a flood last year. The reconstruction of the dam is necessary in order that farms in the vicinity may have an adequate supply of water. Chicago capitalists are said to be ready to take the receiver's certificates.

Massachusetts capitalists are now engaged in the construction of an irrigation system to water land on Dead Ox Flat, near Ontario. About $75,000 has been expended on the first unit of the plant, which will be ready for operation this year. Nearly 10,000 acres will be brought under irrigation by this unit. The company has nearly 20,000 additional acres which may be watered through additional pumping facilities.

To recover more than 95,000 acres of land in Southern Oregon, the government has recently brought suit against the Southern Oregon Company, as successor to the Coos Bay Wagon Road Company. By the terms of the federal grant this land was to be sold in tracts of not greater size than 160 acres and for a stipulated consideration. The government maintains that this stipulation was violated, that all except about 7,000 acres was sold to Joseph Miller, agent for Collis P. Huntington, Charles Crocker, Leland Stanford and Mark Hopkins, and a fictitious mortgage is alleged to have been given on this land to defeat the government restrictions.

UTAH.

James A. Melville, who promoted several irrigation projects in Millard County, has recently visited this district in company with several capitalists. As a result of their examinations he claims that financial affairs have been adjusted and that active construction work will begin next spring. Several thousands of acres along the Salt Lake route will be reclaimed through these projects.

The Green River Irrigation Company of Emery County called for bids for completion of the dam across the Green River and the widening and deepening of the raceway to be submitted on January 16. The company also asked bids for the construction and installation of a pump plant to lift water from the raceway to the ninety-foot canal. The company also offered for sale on this day bonds to the amount of $201,000, bearing interest not to exceed 6 per cent.

The Washington Irrigation Company of Francis, Summit County, has filed amended articles of incorporation allowing it to conduct a general irrigation business and permitting the operation of municipal water plants. James Prescott, president, and Thomas Atkinson, secretary.

Governor Spry is quoted as authority for the statement that the state of Utah will probably complete the Piute Irrigation project. It is believed that the state can complete this work at a minimum of cost and can then sell the entire project at a considerable profit.

On December 7 the Municipal Irrigation Company

GOODYEAR TIRES LEAD AT AUTOMOBILE SHOW.

More cars were equipped with Goodyear tires than any other kind among the exhibits in the automobile show at Grand Central Palace, New York. The tire census taken among the exhibits showed a total of 32 cars out of the 119 exhibited fitted with Goodyear tires. The Goodyear had a good lead on its nearest rival, which was represented on 19 machines.

The premier showing of the Goodyear tires gives an idea of the standing of that tire in the eyes of the manufacturers of standard motor cars. The exhibitors all want their cars to make the best possible showing at the show and for that reason they are always equipped with the tires that the manufacturer feels are the best.

The unsolicited testimonial to the Goodyear places it in the proud position of being considered the best tire made by a large number of the manufacturers of standard motor cars.

of Green River held an election to vote on the question of a $183,000 bond issue for the purpose of finishing the dam and to construct nine miles of canals.

At the annual stockholders' meeting of the Huntsville Irrigation Association, held December 12, the following officers were elected: Albert H. Garner, president; John G. Hortenson, vice-president; Francis Bingham, Peter Johansen and Joseph Engstrom, directors; C. C. Wangsgaard, treasurer, and A. P. Renstrom, secretary.

At the annual meeting of the stockholders in the Utah and Salt Lake Canal Company the following directors were chosen: James L. W. Dansie, C. C. McMullin, M. J. Leak, M. R. Porter, R. D. Coates, Peter Larson and H. T. Spencer. According to the report of President Peter Larson the company now has more than twenty-six miles of canal in operation.

The Pleasant Creek Irrigation Company has filed articles of incorporation showing capitalization of $20,000. James H. Seeley is president, Neils Matson vice-president and W. D. Candland secretary and treasurer.

Nearly all stock in the West Cache Irrigation Company has been purchased by the Trenton Irrigation Company, into which it was proposed to merge the former company in order to avoid legal troubles. The Trenton Company is composed of the following stockholders: J. A. Hendricksen and Joseph E. Cardon, Logan; Ephraim Bergeson, Cornish; B. Y. Benson, Trenton, and M. C. Rigby, Newton. The new company is capitalized at $400,000. John A. Hendricksen is president.

Officers of the Price River Irrigation Company held a meeting in Salt Lake during December, at which it was predicted that they would close negotiations for the purchase of the Irrigation Land Company for $50,000. Owners of the Price River Company are T. R. Cutler, Ira Wines, Austin Brothers, George Sauerback, George A. Smith, A. B. Rockhill and T. W. Boyer. Engineers report that when the reservoir, now under construction, is finished it will store enough water to irrigate 20,000 acres.

Farmers in Salt Lake County held a meeting at Sandy to discuss the advisability of building an irrigation system to water 2,000 acres. Professor Lyman, of the University

of Utah, indorsed a plan for irrigation by pumping. It is expected that success in this project will be followed by numerous others in this vicinity.

Articles of incorporation have been filed by the Uintah Land and Water Company at Salt Lake. Capital, $200,000. It is proposed to interest local capital in irrigating 25,000 acres west and south of Vernal. Officers of the company are: James A. Mellville, president; R. S. Collett, of Vernal, vice-president; Henry T. McEwan, treasurer; J. W. Musser, secretary. These, with O. P. Miller, C. B. Stewart, E. H. Marshall and B. D. Nebeker.

Work on the waterway of the Davis and Weber Counties Canal Company has been discontinued until early spring. Six and one-half miles of the nine and one-half miles have been concreted and are ready for water. Engineer Bostaph predicts that the canal will be ready for water during the coming season.

Reports from St. George give details of the incorporation of the Virgin River Irrigation Company, with a capital stock of $100,000. It is proposed to reclaim 100,000 acres in Washington County and vicinity. Filings have been made on the waters of the Virgin River and its tributaries. The incorporators are: J. M. Loweitzen, W. S. Rust, R. D. Young, S. A. London, John R. Wallis and L. A. Snow, all of St. George, except Rust and Young, who are of Manti and Richfield, respectively.

WASHINGTON.

Camplain & Gillett, of Goldendale, have engineers in the field making preliminary surveys for an irrigation system near Carp Lake, nine miles north of Goldendale, which will be used as the reservoir. Condemnation proceedings have been filed for a ditch right of way and other reservoir sites. Several thousand acres to be watered by this project have heretofore been devoted to fruit and grain, but it is proposed to encourage dairying after water is supplied.

Articles of incorporation for the Whitestone Irrigation and Power Company of Loomis have been filed. This company is now constructing a project in the northern part of Okanogan County covering about 10,000 acres and

embracing the Whitestone Flats, the Horse Spring Coolie country and lands lying across the Okanogan River. Water from four creeks will be stored in reservoirs ten miles south of Loomis. Active business operations will commence early in the spring in order that the system may be completed for the season of 1912.

Farmers interested in irrigation in the lower Eureka met recently at Walla Walla and planned to reclaim 50,000 acres of sandy waste in that vicinity. Articles of incorporation were filed with the county auditor. It is proposed to plant alfalfa and fruit on the reclaimed land.

A concern known as the Samuel Hill Syndicate has completed its dams and reservoirs for the irrigation of 60,000 acres west of Cliffs. It is proposed to augment the natural supply of water by a pumping system and to have the supply ready for use during the present year.

Holders of preferential rights to entry under the Tieton government project will not be recognized by the Department of the Interior. Circulars recently received state that "no contest will be allowed against any entry embracing land included within the area of any first form withdrawal land reserved for irrigation purposes, commonly known as land under the second form of withdrawal, until the Secretary of the Interior shall have established the unit of acreage and fixed the water charges and the date when the water can be supplied and made public announcements of the same as in all cases where a contest has been allowed prior to any such withdrawals; the withdrawals, if made before the termination of the contest, will ipso facto terminate all rights that were acquired by reason of such contest."

Through a reorganization affected by H. P. Carlyon, promotor of both companies, the Olympic Tide Land Company will be dissolved and merged into the Carlyon Reclamation project. The land controlled by the latter company is located near Olympia. It is reported that the Carlyon Company will be in a position to proceed with active work in the early spring.

The Palouse Irrigation and Power Company, finding that its old dam was inadequate, has replaced it with a concrete dam which will supply sufficient water to irrigate the 4,000 acres in this project.

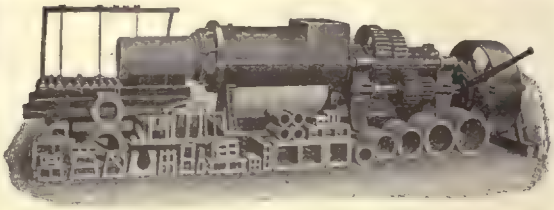
Lauchlin Maclean, chairman of the Committee on Irrigation of the Spokane Chamber, is making a canvass among business men in Spokane to raise $5,000, the amount required for a permanent survey of the Quincy Valley in Grant and Douglas counties, 135 miles west of Spokane, where 300,000 acres of land is to be put under ditches. It is expected that the work will begin early next spring.

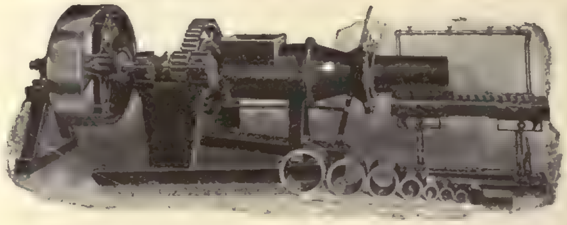
The Tukanon Valley, comprising 12,000 acres of fine bottom land, is to be developed and put under a gravity irrigation system by an association of capitalists.

Colonel J. C. Murphy, of Seattle and Pascoe, is giving his personal effort in the interest of the completion of the Government Palouse Irrigation project. The Reclamation Service completed surveys for this project in 1905, but never began active construction. By interesting commercial clubs at Tacoma and elsewhere, Colonel Murphy expects to be able to bring sufficient pressure to bear upon officials to insure early operation. About 101,000 acres of Franklin County land are involved. According to the original plan it was proposed to take flood water from the Palouse and through the canal past Kahlotus Lake and across the lower end of the Connell Coolie and to store it in this coolie.

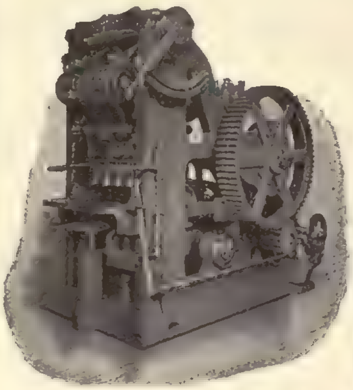
J. B. Early, head of the contract department for the Klickitat Irrigation and Power Company, is authority for the statement that work on this project will begin in the early spring. Water from the Big Klickitat River will be stored near Prosser for a 240,000 tract. It is estimated that the construction cost of this project will be $12,000,000. Additional water will be taken from the Columbia River.

70-Acre Cherry Orchard on the Fountain Valley Land and Irrigation Company's Project.


Centennial Auger Machine


Mascot Auger Machine


Wheelbarrows and Trucks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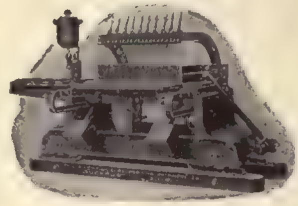
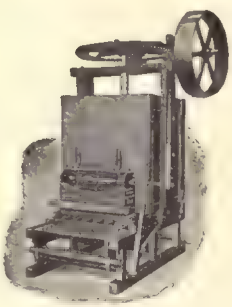

Hand and Power Cutters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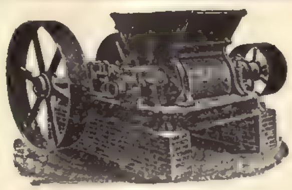
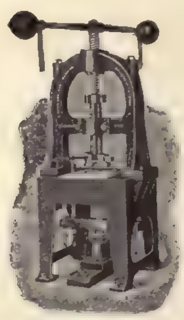
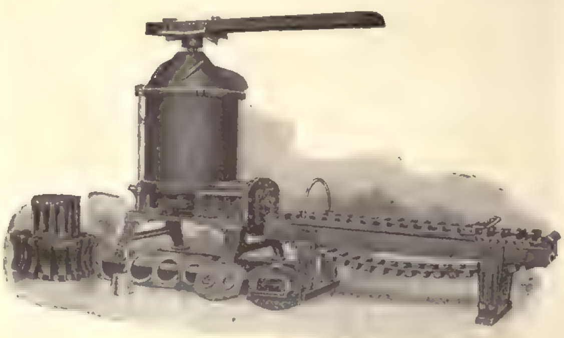

Disintegrators


Hand Power Screw Press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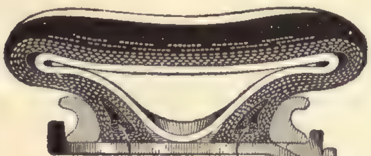
We have sold half a million Good-year No-Rim-Cut tires at 20 per cent more than the price of other standard tires. Last year our tire sales trebled — jumped to $8,500,000.

All because the tires can't rim-cut, and because Goodyear tires are 10 per cent oversize.

Now these same tires — No-Rim-Cut tires—tires 10 per cent oversize — cost no extra price. Our multiplied output has cut the cost of production. All motor car owners should insist on them now.



The 63 Braided Wires

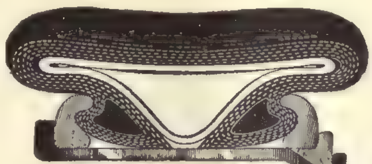
No Rim-Cutting

The picture shows how a Goodyear No-Rim-Cut tire fits any standard rim for quick-detachable tires. Also demountable rims.

Note that the rim flanges—which are removable—are turned to hook outward with No-Rim-Cut tires. There are no hooks on the tire base to hook into this flange as there are on other tires.

The rounded flange comes next to the tire casing, and rim-cutting is made impossible. Half a million of these tires have been used.

We have run them flat in a hundred tests—as far as twenty mlies. Yet there has never been a single instance of rim-cutting.



The Cause of Rim-Cutting

The above picture shows how an ordinary tire—a clincher tire—fits this same standard rim. The removable rim flanges must be turned to face inward—to grasp hold of the hooks in the tire. That is how the tires are held on.

Note how that thin edge of the rim flange digs into the tire. That is what causes rim-cutting. That is how tires are wrecked beyond repair if you run them flat, even for a few hundred feet.

That rim-cutting ruins more automobile tires than any other single cause.

How to Avoid It

The difference is simply this: In the Goodyear No-Rim-Cut tires there are 63 braided piano wires run through the base on each side. That makes the base unstretchable. The tire can't creep on the rim, and nothing can possibly force it over the rim

When these tires are inflated the braided wires contract. They are then held to the rim by a pressure of 134 pounds to the inch.

That is why Goodyear No-Rim-Cut tires don't need to be hooked to the rim. The rim flanges can be turned to hook outward, and you can't rim-cut the tire.

Other makers, to meet our competition, run a single wire through the base; or they use a hard rubber base. But neither plan will do. The braided wires, which contract under air pressure, are absolutely essential to a safe hookless tire. And we control that feature.

Goodyear Tires 10% Oversize

Here is another feature which, with the average car, saves 25% on the tire bills.

The Goodyear—while it fits the rim—gives you 10% more tire for your money. That means 10% more carrying capacity. It means, with average conditions, 25% more mileage per tire.

The reason is this:

Motor car makers, in adopting tire sizes, figure on the weight of the car as they sell it and the weight of the passengers at 150 pounds each.

They supply the tire size to support that load, but they rarely leave any margin. They cannot afford to at the present prices for cars.

You may add a top, a glass front, gas lamps, gas tank, an extra tire, etc. And passengers may over-weigh. With nine cars in ten the expected load is exceeded. The result is a blow-out—often while the tire is new. Overloading with the average car, adds 25% to the tire cost.

We Save That 25%

When you specify Goodyear No-Rim-Cut tires you get 10% oversize without extra cost. That prevents overloading. It adds, on the average, one-fourth to the tire mileage.

We give you this extra size without extra cost to protect our reputation. When tires are wrecked by overloading, one naturally blames the tire maker. We wish to avoid that blame.

There are many other things you gain when you specify Goodyear No-Rim-Cut tires. They are all told in our book, **"How to Select an Automobile Tire."** Ask us to send it to you.

GOODYEAR

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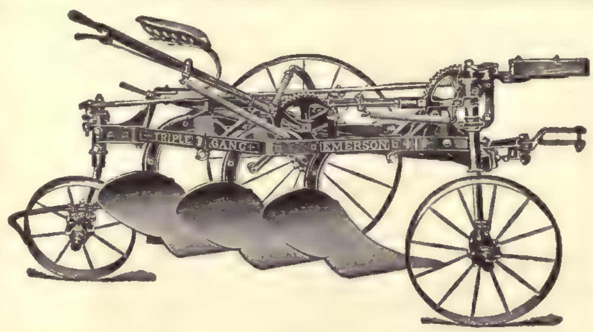

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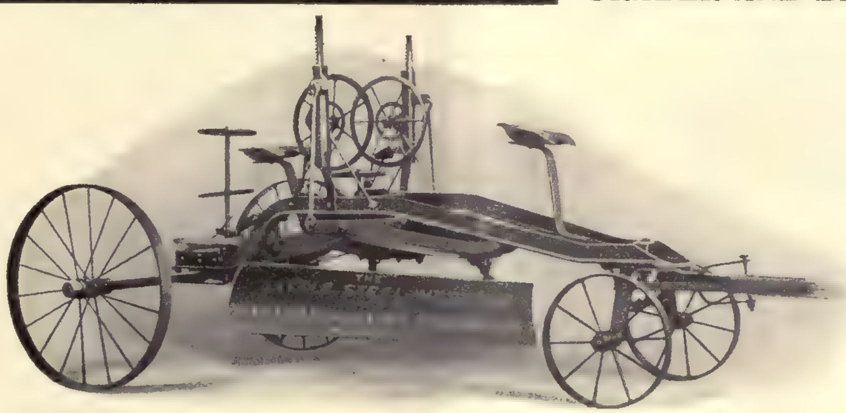

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THE IRRIGATION AGE

VOL. XXVI CHICAGO, FEBRUARY, 1911. NO. 4

THE IRRIGATION AGE
With which is Merged
MODERN IRRIGATION — THE DRAINAGE JOURNAL
THE IRRIGATION ERA — MID-WEST
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D. H. ANDERSON
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112 Dearborn Street, - - CHICAGO

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Official organ Federation of Tree Growing Clubs of America. D. H. Anderson, Secretary.

Official organ of the American Irrigation Federation. Office of the Secretary, 212 Boyce Building, Chicago.

Interesting to Advertisers.

It may interest advertisers to know that The Irrigation Age is the only publication in the world having an actual paid in advance circulation among individual irrigators and large irrigation corporations. It is read regularly by all interested in this subject and has readers in all parts of the world. The Irrigation Age is 26 years old and is the pioneer publication of its class in the world.

Open Department of Correspondence

The publisher of the IRRIGATION AGE is desirous of establishing permanently a correspondence department in its columns, and with that in view suggests that all of our readers who have any matter of news to contribute, or who may encounter difficult conditions incidental to the work of developing an irrigation ranch, correspond with us so that the matter may be presented in type to the thousands of our readers. You will, no doubt, by reading this department either be able to derive benefit from the experience of others or attain thereby knowledge from those who have overcome difficulties in their farming operations. This department may be made not only an interesting but an instructive one as well, and can be maintained permanently only by the co-operation of our readers.

Wonderful Increase in Circulation

It may interest our readers to know that the circulation of the IRRIGATION AGE has shown marked growth during the past few months. There has never been a time in the history of this publication when new subscribers have come in so rapidly, nor have we ever received in the same length of time so many voluntary renewals from old subscribers.

We are publishing in this issue a few of the testimonials received from our old readers which are very gratifying, indeed, to the publisher.

It may not be out of place at this time to call to the attention of our readers the fact that the advertising carried in the columns of the IRRIGATION AGE is of the very highest quality. The publisher of this journal will not in any instance accept questionable advertising and is particularly careful about accepting advertising from land companies so that the readers may not be misled into buying lands of questionable value.

The readers of the AGE may rely at all times upon statements made by advertisers in its columns and in any instance where the advertiser fails to make good an investigation will be made by the publisher on receipt of complaint by a subscriber.

Much Indignation In Oregon

There is much indignation among the people of Oregon over the fact that the Army Board, appointed by the President to investigate reclamation projects and see that a proper disposition is made of the funds (including the $20,000,000 loan), was much more favorable to Idaho and Montana than to Oregon.

It is alleged that pressure or influence persuaded the Army Board to ignore certain projects throughout Oregon which presented features of more than ordinary merit.

Idaho secured $7,000,000 of the lump sum and Montana $8,000,000, while Oregon must content itself with a paltry $925,000 from the combined fund of $45,000,000.

There is much criticism in Oregon concerning her senators, who it is claimed have not gone about the matter properly. Senators Borah of Idaho and Carter of Montana, the best posted men in the senate on western needs and irrigation in particular, were successful in landing good plums for their respective states and the Oregon

people feel that their senators should have been equally alert to obtain a slice from each of these sums secured by the other states.

Were the Oregon senators sleeping? is the question their constituents are asking themselves.

There is no doubt but there are opportunities for development along irrigation lines in Oregon equal to those of any state in the western country. Oregon has climatic conditions that particularly recommend her as a residence section.

The fruits from this state are world-renowned. It may not be too late for the Oregon senators to have some change made in favor of their state.

It is said that R. S. Lovett, the successor of Mr. Harriman, is inclined to join with Oregon in its fight for a fair share of the federal reclamation fund.

National Irrigation Association Again

We note from a clipping in the Dallas, Texas, *News* that the National Irrigation Association indorsed Senator Newlands' new water-way plan, which the *News* classified as a gratifying item in the news of the day and maintains that Senator Newlands has shown that he views these problems on rather a broad scale.

The *News* states, moreover, that it is hard to discover in a definite way just what Senator Newlands' plan is from the outline which the National Irrigation Association appends to its indorsement.

It may be well to state for the benefit of the Dallas *News* that those who are acquainted with the organization known as the National Irrigation Association were of the opinion that it met its death blow at the Irrigation Congress, held at Portland, Oregon, some years ago.

It may be well also, to state that this association was a one-man affair, conducted for and by one George H. Maxwell, who, in the early history of the movement toward national aid for irrigation development, became conspicuous as a lecturer, paid by corporations who felt that some activity was necessary in order to stimulate sufficient interest throughout the central states to bring the matter to a focus.

It is the impression of this journal that Senator Newlands would better look for the indorsement of some organization of known standing and repute, rather than go back to the defunct institution which was conducted by Maxwell, and through which large sums of money were obtained by him ostensibly for the extension of the irrigation propaganda.

It is safe to say that the IRRIGATION AGE has consumed one hundred pages of space in explaining to its readers the position of Maxwell and his connection in bolstering up weak-kneed and, in many instances, incompetent government officials.

This association was repudiated by the Executive Committee of the National Irrigation Congress at Portland, Ore., in 1905, and very little has been heard of it since that date.

New Mexico Greater Under Statehood

The report of Territorial Engineer Vernon L. Sullivan, of New Mexico, is out and contains very valuable data. A copy of this report will, no doubt, be sent to all who make application for same.

Secretary H. B. Hening of the Bureau of Immigration states in this report that the progress of New Mexico will be much greater under statehood. This statement is based upon the actual correspondence received by the department from responsible individuals interested in irrigated lands in New Mexico.

This report is a long one and is finely illustrated and shows an amazing increase in the number of applications for water rights. Engineer Sullivan predicts that the admission of New Mexico as a state will have the immediate effect of starting the construction of a lot of new projects and refers to them as "bona fide projects backed by reputable men ready to do business."

New Mexico, with her particularly fine climate and large areas of wonderfully productive soil, would lure many of the eastern and central homeseekers within her borders if all of the advantages possessed by her could be properly brought to their attention.

As a result of representations by Secretary Hening, the Commercial Club of Albuquerque has appointed a committee to investigate the fruit growing possibilities of the Rio Grande Valley and devise ways and means for placing this industry on a paying and commercial basis.

Following the suggestion of Secretary Hening, the club will secure the services of one of the foremost expert horticulturists of the country to make a thorough investigation and report to the club.

It is believed that properly encouraged fruit raising in the central Rio Grande Valley will make that section celebrated as the home of the big red apple.

Those who are desirous of securing information on New Mexico may obtain it by addressing H. B. Hening, Secretary, Bureau of Immigration, Albuquerque, New Mexico.

Oregon Attracts Chicago Wealth

The Rogue River Valley of Oregon is becoming a great winter resort for eastern people. They have now what is known as the Millionaire Colony of Medford, which contains a large number of names of people who in recent years have figured prominently in social affairs in Chicago and other large cities in the central states.

Mrs. Potter Palmer is said to be interested and contemplates spending some time in this delightful section.

Many who have gone have invested in lands, while in other cases they are only sojourners in search of health and contentment.

It is estimated that more than $3,000,000 have been invested by former residents of Chicago in the orchards of that valley and any one of the homes that have been established there by the Chicago people is of sufficiently good character to make its owner forget the attractions of Chicago and the allurements of life in a metropolitan city.

The fact that people of means are going out into this country for their winter homes speaks well for the climate of Oregon.

Those of us who have been permitted to make occasional visits to Oregon are familiar with these conditions, but it has not been until recent years that this delightful valley, which parallels the Pacific Coast line in Oregon and northern California, has become accessible to tourists. It was formerly the custom to make the trip from Portland to San Francisco, or from San Francisco to Portland, by steamer. Since, however, the Harriman systems have established good railroad accommodations up and down the coast, people have become better acquainted with the delightful climatic conditions and the resources of this great storehouse of minerals, accompanied by its capacity for producing the finest fruits and other crops to be found in the world.

It seems a long distance from Chicago to Oregon, and one who makes that trip for the first time feels that he

is a great distance from eastern conditions and what is known as Civilization.

There are, however, to be found many beautiful cities all along the Pacific Coast and it would be difficult to find a more delightful and complete city than Portland, Oregon.

When one settles in a valley like that of the Rogue River, or the Willamette, he is sufficiently near to Portland to feel that all of the benefits to be derived in the way of entertainment, as well as of a social manner, are close at hand. While, on the other hand, one is so near to the wildness of the mountain ranges that all of the allurements of a mountain wilderness are open to the sportsman, or those in seach of health.

Taken all in all, it is doubtful if there is to be found within the borders of the United States a more pleasing combination than may be secured in this section of Oregon.

To Amend Water Code.

Representative McKinney of Baker County, Oregon, Chairman of the Committee on Irrigation of the House, introduced a measure recently which amends the water code of 1909 in many respects in compliance with the recommendation of the State Engineer and members of the Water Board of Control.

It also provides other things: for instance, an increase in salary of the State Engineer, as suggested by the acting governor in his message.

The amendments in the water code are principally to facilitate the work and the practice before the water board and relate for the most part to matters of procedure. These amendments will operate so as to make the law conform to what the experience of the board in the two years the bill has been in effect, has demonstrated it should be. The amendment asks for an additional fund of $5,000 for surveys to be made in connection with the adjudications of the water board of control.

Owing to its rapid development in the irrigation field, Oregon is entering a period which will require many changes in its present irrigation laws and these should be carefully investigated so that no errors may creep in which may prove detrimental to the water users or citizens generally.

Misleading Information About Canada

In a letter received from a subscriber, who is a settler in the Canadian northwest, dated January 29th of this year, it is stated that the weather since the last week of December has been very cold and stormy, being 35 and 40 degrees below zero.

The writer further states that the crops last year were very light owing to the dry weather, the smallest ever known since our correspondent moved to that country.

This statement is somewhat at variance with the character of literature being put out by the Canadian Pacific Railway, that claims almost everything for the northwest territory.

The AGE has found occasion in former issues to criticise the officials of this system for statements which, to put it mildly, may be classed as misleading; it is unfair to lure settlers who are doing fairly well in the United States to that country, where they oftentimes meet with discouragement and disappointments.

A farmer who is prospering in the States should consider long and well before moving across the line.

There are, no doubt, many favorable locations throughout Sasakatchewan and Alberta, and it is equally true that many of the settlers from here have gone over there and accomplished much in the way of building up a home and producing good crops. The same inducements, however, are offered by our own states in the west, and it is safe to say that there are many of the western states that can be depended upon to treat the settler better in the way of results than any section in the northwest part of Canada.

The writer is not prejudiced in any way against Canada; in fact, was born in that country and has, naturally, a kindly feling for its government and people, but the fact remains that there are many who go over there with a misunderstanding of the opportunities offered, and this is the result of the highly romantic and colored literature put out by the Canadian railways.

Committee Holds Heated Sessions.

Dispatches from Washington late in January inform us that the Senate Committee on Irrigation, which met behind closed doors, has been holding heated sessions over the attempt of Chairman Carter to "use the committee to injure Director Newell and the friends of conservation."

To those who are not familiar with the history of irrigation development, these lines would indicate that Senator Carter is some sort of a hydra-headed creature who is attempting to deprive Mr. Newell of some of his prerogatives and to withhold opportunities from prospective settlers in the West.

Those who are familiar with the history of irrigation development under Federal control readily understand that Senator Carter is one of the best inofrmed men in the Senate on irrigation affairs. Both he and Congressman Mondell, of Wyoming, have given this subject a great deal of thought and study and when Mr. Carter was selected chairman of the committee and acted as the head of that committee and its investigations, something over a year ago, those who were familiar with the situation felt that a report of the exact conditions as existing, would be presented. The report was prepared, so we are informed, in full and the committee was asked to sign it, but several of them refused and it is assumed that those who refused were less familiar with conditions, or members who had been approached by the alleged father of the forestry and conservation movement, Pinchot, and by some of the friends of Director Newell.

It is not necessary for us to state at this time our opinion or knowledge of either Messrs. Newell or Pinchot. The AGE has devoted a great deal of space to these gentlemen in the past and all of our readers fully understand our position.

It is a well known fact that there has been a sort of lobby conducted in Washington with a view to popularizing certain individuals; among them, Pinchot, Newell, Ex-Secretary of the Interior Garfield, and one or two others who have been boosted through the assistance of this coterie of conservationists to live positions, such for instance as head of the Smithsonian Institute. This group of men attempted at one time to control all western legislation and development.

There was a time, not many years ago, when, if one picked up a daily paper and failed to find either the name of Pinchot or Newell in its columns, the question would arise as to what delayed the matter in reaching from the press bureaus at Washington and Chicago to the newspapers on their list.

This fight has been toned down somewhat by Pinchot's enforced retirement as chief forester and by the fact that

Secretary Ballinger has held Newell in line to his work, rather than allow him to canter over the country as heretofore.

It is noticeable, too, that the quantity of press matter sent out concerning the reclamation and forestry department has been much reduced and, in fact when we get news about either of these departments now it is news rather than gush and praises of the individual at the head of each organization.

Senator Carter will, no doubt, put his report in the hands of the press for general circulation and it will no doubt demonstrate that Newell is incompetent and unfit for the position he holds, as the AGE has always maintained.

Allurements For The Unwary. Irrigation investments have grown within the past years to be a favored form of investing money in the West, and, like all other speculation, offers allurements for the unwary, as well as the solid investor. In great movements, such as that of irrigation during the past ten years, great opportunities have been offered to the unscrupulous promoter of wildcat schemes to separate unsuspecting individuals from their hard-earned money.

THE IRRIGATION AGE has known of many instances where money was being secured in very large sums through a sort of half-lottery system—a system not quite close enough to the designation "Lottery" to bring the promoters within the law. It has on several occasions been the intention of the editor of this journal to expose these schemes, and this would have been done long ago had it not been for the fact that there was a possibility of injuring by such exposure the reputable and substantial irrigation projects throughout the country.

It would have been better, perhaps, to warn the public in the early stages of rapid development and to have given them definite knowledge of one or two of these wildcat projects.

Schemes of this character usually fall of their own weight, and this has proved true in recent cases that have come to our attention through the columns of western journals.

One of the alleged wildcat projects of the western slope in Colorado has been overtaken by litigation. This was known as the Escalante Irrigation Reservoir Company of Delta County, for which a receiver was this week appointed by a local judge upon request of stockholders who alleged fraud in the methods of the promoters in filing upon and acquiring land under the proposed system.

Injunctions were also issued against several other irrigation and ditch companies of Delta County. Some of the promoters are at present under bonds to appear at the February term of court to answer to an information filed in September against them, and they will be given an opportunity to explain their connection with the alleged irregular selling of stock.

It is charged that many farmers and investors of western Colorado have been victimized.

These facts are set forth in the columns of THE AGE to emphasize to its readers the advisability of using great caution in investing in prospects about which little is known, and whose promoters are still less known.

The fact of the matter is that a great many people purchase lands and stock without ever having investigated the quality or productibility of the lands, or the area upon which the stock value is based.

There are very few people who would walk into the office of a reputable real estate man of any city and accept his mere word as to the quality and value of a piece of land which he contemplated purchasing, and THE AGE cannot understand how these same individuals are oftentimes induced to purchase from persons unknown other than through well-worded advertisements, lands and bonds of questionable value and of which they have no definite knowledge other than that given by the seller.

If the writer of this article were to state to some friend that he had a piece of land for sale at some point nearby Chicago, specify its location, quality of the soil and its value, he would consider the possible purchaser a man of very little sense and discernment if he would accept his mere statement and lay down his money for it. Why, then, should people who are desirous of securing land for western homes accept the statement of a comparative stranger, The answer is simple to those who understand the inordinate craze for western land. The main thought is to secure a land holding in some desirable locality in the west and less thought is given to the individual offering it than to the quoted merits of the prospect or the lands offered.

Many complaints come to this office from people who have purchased lands and now find that they have been deceived.

There is no remedy that we know of unless they apply to the government officials and have the sellers of this class of property investigated.

If a man is selling land of questionable value for a good price through newspaper advertising and the mails, the Post Office department may readily get him. If, on the contrary, a man is selling lands from his office direct to the individual, who accepts the seller's statement of its value without further investigation, there is no recourse, except by some suit at law for obtaining money under false pretenses, which is often a long drawn out and expensive procedure.

THE IRRIGATION AGE is not inclined to go into this subject often or too deeply, but offers these suggestions as a protection to those who may be of the class above described.

IRRIGATION PROMOTERS ARE INDICTED.

Charged with using the United States mails to further an irrigation scheme in Colorado, declared in a statement issued by the Interior Department to be "wildly and flagrantly fraudulent,' seven residents of that state have been indicted as a result of the combined efforts of the Interior and Postoffice departments. The men are held under $2,500 bail.

Their names as given out by the Interior Department are: J. Albert Wright, Frank White, John Gould, Corydon A. Woody, Homer A. Gibson, Robert W. Rose and Sam M. Baker, all of whom are said to be officers in one or more irrigation companies.

The charge, it is said, is that they procured about fifty citizens to make desert land entries in the Montrose, Col., land district upon the representations that the several corporations would construct an irrigation enterprise which would irrigate the lands.

Entrymen were procured, but before making the entries they were required, it is said, to agree or contract to deed to a land and irrigation company, when patent was secured, all of the land except ten or twenty acres of the 320 acres in each entry, in return for which the company was to furnish the entryman his water supply. The land involved in the case is valued at approximately $160,000.

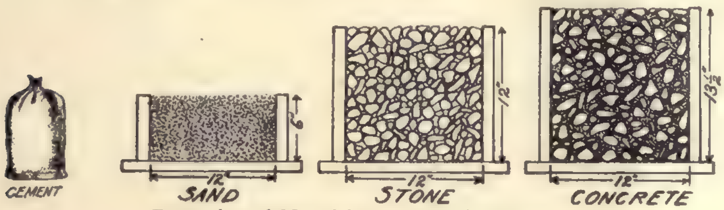
Reports on the entries were submitted by the general land office, following which the matter was turned over to the Postoffice Department, resulting in the indictments.

MIXING CONCRETE ON THE FARM

How to Select Your Materials and Mix Your Own Concrete

On account of its cheapness, uniformity, and quick development of strength, the only cement practically used at present is the kind called "Portland." There are almost as many brands of Portland cement as there are of wheat flour. For farm work choose some brand guaranteed by the local dealer to meet the standard specifications of the American Society for Testing Materials, which standards are approved by the National Government.

Cement takes water so easily that care must be exercised in storing it. Upon the regular floor of a good building place timbers close together, as a support for a false floor, upon which the cement should be piled.



Proportion of Materials and Resulting Concrete.

KEEP THE CEMENT DRY.

Cement is heavy; do not overload the floor of the building by piling it too high, and do not store it against the side walls. Keep it covered with canvas or roofing paper. Cement once wet sets up and is unfit for use. However, lumps due to pressure in the store house must not be mistaken for set-up cement. Such lumps are easily crumbled and may then be used.

DO NOT BUY STONE SCREENED TO ONE SIZE.

Concrete is a mixture of Portland cement and particles of stone. The stone should vary in size from pieces one inch in diameter to sand grains. By so grading the stone, the smaller particles fit in the spaces between the larger pieces, thereby producing the most compact and the strongest mixture.

The best stone for crushed rock is one which is clean, hard, and breaks with sharp angles. Trap, granite, and hard limestone are among the best; the use of shale, slate, and soft limestones and sandstones should be avoided. The crushed rock should be screened on a ¼-inch screen to remove the fine particles. These small particles should be considered as sand; and, if insufficient in quantity to make the proper proportion of the concrete, as is described later, enough sand should be added to them to produce the required amount.

WELL-GRADED GRAVEL GOOD.

Gravel well graded in sizes is at least equally as good for concrete as crushed stone. Bank-run gravel just as dug from the pit, seldom runs even and rarely has the right proportion of sand and pebbles for making the best concrete. The mixture most suitable has one part sand to two parts gravel, measured by volume, in which all sizes passing through a 1-inch-mesh screen and retained on a ¼-inch screen are considered gravel. As there is usually too much sand for the gravel, it is both advisable and profitable to screen the material and to remix them in the proper proportions. Gravel should have no rotten stone and should be clean, so that the cement may adhere to it tightly.

SAND MUST BE CLEAN.

With dirty sand, no amount of cement will make strong concrete. Generally sand is clean, but if not, it can easily be washed by playing a hose or flushing water upon thin layers of sand placed on a tight-jointed inclined wooden board. In size of grain it should vary uniformly from fine to coarse. All particles passing a ¼-inch screen may be considered sand.

Any good-tasting drinking-water is suitable for concrete.

NO GREAT EXPENSE FOR TOOLS.

The tools and equipment necessary for making concrete in moderate quantities are already at hand on a well conducted farm, or will be used afterward for other purposes. The list:

2 square pointed "paddy" shovels, No. 3.
1 round pointed tiling shovel or 1 garden spade.
1 heavy garden rake.
1 sprinkling can or bucket or 1 spray nozzle for hose.
1 water barrel or 1 length of hose.
1 sidewalk tamper or home-made wooden tamper.
1 sand screen made of a section of ¼-inch wire mesh nailed to a wooden frame.
1 measuring box or frame. See description further along in article.
1 mixing board.
2 wheelbarrows with steel trays.

PROPER PROPORTIONS FOR FARM WORK.

For farm work the following proportions are most suitable:

For concrete necessarily waterproof	1 : 2 : 4	or 1 : 4
For all other ordinary purposes	1 : 2½ : 5	or 1 : 5

Such proportions of three parts, as 1 : 2 : 4 indicate that the concrete is to be mixed 1 part cement to 2 parts sand to 4 parts screened gravel or crushed rock; and 1 : 4 that it is to be mixed 1 part cement to 4 parts bank-run gravel.


Mixing Board, Tools, Etc.

Measurement by counting shovelfuls is poor and uncertain practice. To avoid splitting of bags of cement, make as the unit of measurement 1 cubic foot, the amount of loose cement contained in one cement bag. Such measure-

ments are made a very easy matter by gauging the wheelbarrows. For this purpose use a bottomless box holding one cubic foot. A shallow bottomless frame is also a convenient means of measuring. Such a frame, when set on the mixing board and filled, should contain the full amount of sand or one-half the quantity of gravel, or crushed rock, required for one batch of concrete.

USING A "TWO-MEN BOARD."

The size of the batch is dependent upon the amount

Men Shoveling Concrete.

of help and the dimensions of the mixing board or platform. For work of ordinary size, sufficient room will be had on a "two-men board," 8 by 14 feet, framed solidly and covered with one-inch stuff with tight joints the short way of the board. A wooden strip nailed around the outer edges will prevent the loss of liquid cement. For such a board and the proportions designated above, make the bottomless frame of the clear dimensions given in the table below:

TABLE NO. 1—FOR TWO-BAG BATCH.

Proportion	Stacks of Cement	Frameful of Sand	Framefuls of Crushed Rock or Screened Gravel	Clear Dimensions o Frame
1 : 2 : 4 or 1 : 4	2	1*	2	0′6″x2′8″x3′ 0″
1 : 2½ : 5 or 1 : 5*	2	1*	2	0′6″x2′6″x4′ 0″

*For bank-run gravel use the same table, but no sand is required except that which is already in the gravel.

LABOR-SAVING FACTORS IN MIXING.

All the materials (slightly more than the computed quantities) should be on hand before beginning the work. They can often be hauled at odd times. The sand and gravel or stone should be piled so as:—

To cause the least amount of wheeling.

To make the mixing most convenient to the water supply.

To allow room for the future location of the mixing board.

If the gravel does not need screening, place a bottomless frame, previously described for a 1:4 mix, on the mixing board and fill it level full with gravel. Lift the frame, spread the gravel slightly with the garden rake, and upon it distribute evenly 2 bags (the full amount) of cement. Set the frame upon the leveled surface of cement and gravel and again fill it in the same way.

MIX CAREFULLY WITH A RAKE.

. Remove the frame and spread the entire mass by dragging it back and forth with the rake. Two men, opposite each other, then turn the batch with the square pointed shovels. Again use the rake. Keep turning until the cement no longer shows in streaks, until the mixture has a uniform color. Throw up the ragged edges and, with sprinkling can or hose with spray nozzle, apply water in quantity, according to special directions given later for each particular kind of construction. Turn again and add so much more water as may be required. If dry streaks are still evident, continue the turning until they disappear. With wheelbarrows quickly remove the concrete and immediatly use it in the work.

If crushed rock or screened gravel is to be used, fill the bottomless frame with sand and distribute upon it 2 bags of cement. Drag the materials back and forth with the garden rake, then turn, as described above, until the mass has a uniform color. Spread the mixture so that 2 framefuls of crushed rock or screened gravel may be placed upon it. Wet the mass and turn as for bank-run gravel until each stone is coated with cement mortar. Remove as for the gravel concrete.

For the proportion of 1:2½:5 or 1:5 the method of mixing is the same.

Since crushed stone is more or less porous, in dry, hot weather it is advisable to keep the stone pile wet or at least to water the stone well as it stands on wheelbarrows ready for the mixing board.

NO VAST AMOUNT OF KNOWLEDGE NECESSARY.

No vast amount of knowledge and experience is necessary to do first-class work in concrete. Success is dependent upon the care and thoroughness exercised in the

Selection of the materials.

Mixing of these ingredients, and

Protection of the freshly placed concrete.

The placing and protection of concrete and simple schemes for saving time, labor, and lumber in the construction of forms will be considered in the next article on "Forms for Concrete.'

AN IDAHO BOOSTER.

Major Fred R. Reed

Major Fred R. Reed, general agent for the Kuhn enterprises in Idaho in the celebrated Twin Falls country, whose photo is shown herewith, is one of the best known land men in the west.

Major Reed is thoroughly a western man and his efforts in the way of colonization have produced excellent results.

It can be said of Major Reed that his unselfish loyalty to the land of his adoption is part of the history of Montana, Washington and Idaho.

The Twin Falls country, Idaho, owes to Major Reed friendship and good will. His brand is on many of the best irrigation enterprises in the west.

Men Shoveling and Man Raking Concrete.

SUB-IRRIGATION

Important to Drain Tile Manufacturers

Address by D. H. Anderson Before the Convention of Clay Manufacturers Recently Held in Chicago

The subject of drain tile, as associated with sub-irrigation, is an exceedingly important one to manufacturers of that product. I am not desirous of posing as an expert along this particular branch of industry, but at the request of the secretary of your association, have attempted to briefly outline the possibilities of the extension of the tile manufacturing business in connection with the development of our great western country under irrigation.

In order to show the possible benefits to be derived from this system it will do no harm to tell about a novel sub-irrigation scheme that came to my notice some years ago near San Diego, Cal. This system was discovered by Captain Porter of that city and he explained it as follows:

"I have always cussed the gopher," remarked the captain, "but I don't do it any more; the gopher is my friend, and I am in hopes of training him to do systematic work in a way in which I have discovered him to be useful. He beats the band.

"That the gopher is a most indefatigable pest I have had reason to know, for what that rat left undone to my young fig and orange trees, likewise to my pet beet patch, was not worth mentioning.

"There was a particular one that multiplied itself into a regiment of sappers and miners, so it seemed to me, and every morning an investigation disclosed a fine tree lying over on its side, or a choice beet pulled down to the top of its leaves.

"I studied the habits of the rascal, and finally hit upon a plan to utilize his extensive underground operations. I saw him several times, but as he could easily dodge a bullet or a load of shot, I could not exterminate him by the weapons of war. Hence the idea that occurred to me as the only way to get rid of him. By running a ramrod into the ground here and there, I found that there was not a spot of ground two feet square that was not crossed by a branch of the net work of tunnels my gentleman had constructed for the purpose of reaching succulent roots. 'So,' said I to myself, 'if I can find and stop up the outlets I will have him sure.' They were found and hermetically sealed with broken cobbles and earth. Then I turned the hose into the upper end and emptied a three thousand-gallon tank of water into the runways. I persevered for several days, to the great benefit to the young trees and beets by this novel method of sub-irrigation. Mr. Gopher emigrated to a dry climate, I presume; at least I have never had any more complaints to make against him, but I hope he will come back and do some more tunneling. This might not work on a large scale, nor in a prairie dog village, for there are some runways that would exhaust the Mississippi River and a few of its branches before any appreciable diminution of rats would be noticed. However, the waste energies of nature are being utilized to so great an extent that I expect soon to hear of 'trained gophers' for tunnel work in sub-irrigation schemes."

As our country is becoming more thickly populated from year to year the demand for arid land increases; as a result the demand for water increases also.

There are said to be something like 250,000,000 acres of arid land that cannot be irrigated by the flooding or furrow system.

The whole problem of irrigation is to get the best results from the least amount of water, labor and expense, and in the estimation of those who have given it study, there is only one way to fulfill these requirements in certain sections of the country, and that is by sub-irrigation.

It is well known that a tremendous loss of water occurs in irigation by evaporation and seepage, and this has resulted in an effort to feed the plant roots instead of the atmosphere.

Roots of whatever nature will always grow toward moisture; this being true in surface irrigation as well as in what is known as infiltration or sub-irrigation, which is usually carried on by means of drain tile located below the surface of the ground. Water carried by this method spreads out and seeps or soaks out from the conveyor, fan-like, into the soil, from the sides and bottom of the pipe and, following the law of gravity, decends, or ascends, in accordance with the law of capillary attraction.

A question has been raised among those who have studied the matter as to how profitable this system may eventually become owing to the fact that it oftentimes consumes a large quantity of water without supplying the soil with uniform humidity. It is my impression that this is being rapidly overcome by those who are making a careful study of the subject and that eventually sub-irrigation will be the standard method throughout the extremely arid sections of the country.

It has been generally understood that ten per cent is the uniform ratio of evaporation from water lying in reservoirs, but there has never been any well defined statement as to the amount lost by seepage. This has been a serious handicap to many irrigators who are limited as to the supply of water which may be obtained for their land.

The advantages of underground, or sub-irrigation, are too numerous to be ignored. By this system, land too elevated to be reached by water through other means, may be transformed into fertile tracts. It lends invaluable aid to a series of cultures such as grapes, olives, oranges and citrous fruits generally; likewise to gardening.

In addition to these advantages, the application of underground water in arid or waste land covered by sand or gravel permits the propagation and cultivation of profitable, productive plants which would otherwise perish through dryness of the sub-soil.

Upper Klamath Lake—Klamath Project, Oregon.

Finally, a well arranged system of sub-irrigation operates as a drainage system as well as for irrigation.

It is maintained by some writers that the nature of the soil is more important than the configuration of the ground in sub-irrigation. In this respect hard, inpenetrable soils should be avoided for irrigation by infiltration. Experience alone can guide the irrigator in establishing his system of ditches, the main point being always to provide for moistening the ground uniformly.

Under a system of sub-irrigation, where the roots of the plants reach downward toward the source of moisture. cultivation of the field is much more easy and satisfactory, while frequently from surface irrigation, whether by the furrow or flooding process, the plant roots are inclined to come too near the surface of the soil and are thereby injured in deep cultivation.

Nearly one hundred years ago the scientist, Fellenburg, put into the agricultural establishment of Hofwyl, near the city of Berne, a system of sub-irrigation through subterranean conduits, for the purpose of moistening the ground in dry periods when the spongy soil of the gardens commenced to dry and crack, and the turf was not sufficiently packed to permit surface irrigation.

These conduits were arranged so as to serve two purposes: to carry off drainage water or to retain it for moistening the soil. To accomplish this end the pipes were cut at fixed points by a mass of clay which was traversed by a drain which served as a communication between the ends of the conduits, and which could be closed by a movable plug or valve. To cause the water to ascend or flow into the soil, it sufficed to stop or plug up the tubing below the point to be irrigated and the water flowing through the drain rose to its level and flowed into the ground by infiltration.

This idea was approved in England and in 1839 Fellenburg's system was adopted and irrigation by infiltration came into common use, largely, however, for the purpose of flowing liquid manures through pipes to fertilize the sub-soil of arable lands. The system was afterward enlarged and developed into a plan of sub-irrigation where surface irrigation could not be practiced. It was carried to the United States and is now quite common where water is scarce, and in orchards, vineyards, and for deep rooted plants generally.

Frequently farmers in the west, who have small irrigation plants and raise the water from wells by wind or gas power, use part of the water for surface and part for sub-irrigation.

One case with which I am familiar is that of a Mr. Hammant of Colorado, who uses for sub-irrigation a three-inch tile laid fourteen to sixteen inches below the surface in rows five and one-half feet apart, the rows connected by a head row in which is laid one T-joint for each lateral row.

Mr. Hammant says that the rows must be absolutely level and not follow the inequality of the surface in order that the low places may not get more water than the higher ones, and the ends of the rows must be closed with brick or stones so that moles, rats and other vermin cannot get in. A square box set in the ground at one end of the head row gives access to it and thence to all other rows and should have a wire net over the top to keep out trash as well as vermin. He states, furthermore. that the porous tiling and the uncemented joints allow the water to pass through freely.

This mode of irrigation has several points to recommend it, one of which he specified; that one could turn on the water and not find it necessary to watch it, as is imperative in surface irrigation; second, the ground does not begin to bake in a few minutes after the flow of water has stopped, as in the case of cultivated ground under surface irrigation; third, most of the moisture being several inches below the surface, the rootlets go down instead of spreading out near the top of the ground, as in surface irrigation, where they are likely to be burned by the hot sun or torn by the cultivator.

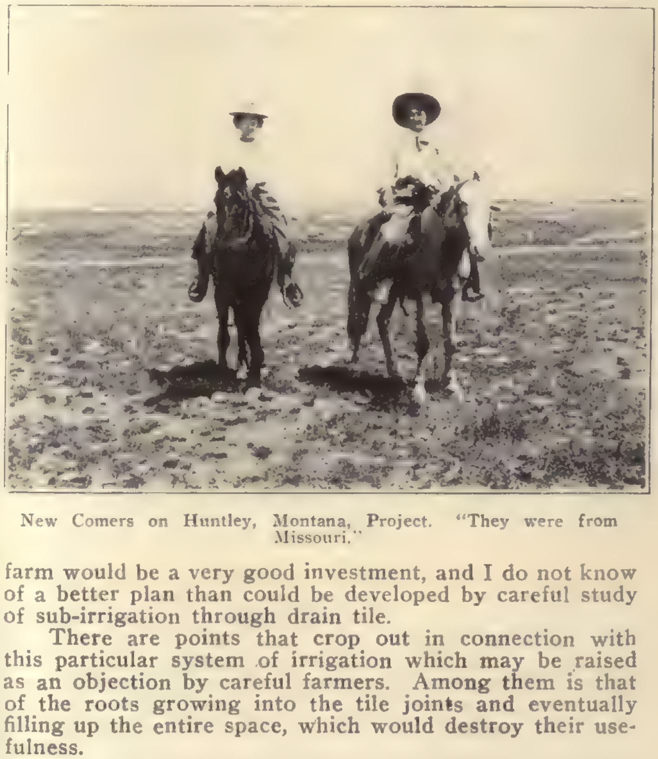
I have not given sufficient study to the subject to know about the cost of tiling for sub-irrigation. This is a matter that should be determined by competent engineers, who are in contact with manufacturers, as well as the ranchman. I fully believe, however, that there is a great field for tile manufacturers in the arid west and this statement would apply also to all other sections of this country where supplemental irrigation may be practiced advantageously by every farmer or truck grower.

This brings to mind the subject of supplemental irrigation as applied to our farms throughout the central and eastern states. Everyone who has made a study of climatic conditions in his particular section will admit that there is always what is known as a "dry spell" during the crop growing season.

I have stated repeatedly through the columns of my journal that supplemental irrigation, either in the form of a sprinkling system in connection with truck gardening, surface irrigation for grains and sub-irrigation for general crops, if practiced intelligently during this dry spell (on a given acreage on any farm, say 10 or 20 per cent of the total area), would save that inevitable dry season loss which every farmer encounters, which often goes to 15 and sometimes 25 per cent or even higher.

If our farmers in the central and eastern states would adopt a well defined system of irrigation on, say, 20 acres out of a tract of 100 acres, and would properly irrigate it through tile, or otherwise during the "dry spell," he would bring the yield per acre up to what would be a normal average, that is to say, about what the average would be with sufficient rainfall to take care of the crops. If by careful cultivation and irrigation of 20 acres during this dry season he could treble or quadruple the crop, this increase would go far to take the place of the loss on the balance of his land.

A reasonable study of this subject, with a moderate expenditure on even so small a tract as one acre, would soon teach him that a system of irrigation over his entire



New Comers on Huntley, Montana, Project. "They were from Missouri."

farm would be a very good investment, and I do not know of a better plan than could be developed by careful study of sub-irrigation through drain tile.

There are points that crop out in connection with this particular system of irrigation which may be raised as an objection by careful farmers. Among them is that of the roots growing into the tile joints and eventually filling up the entire space, which would destroy their usefulness.

It may be possible that this could be easily corrected by the use of a very porous tile with the joints cemented.

Some years ago in Sanford, Florida, a Rev. T. W. Moore put in practice a system of sub-irrigation on the streets of that city to lay the dust. He used an inverted V-shaped trough, under which a stream of water from an artesian well was allowed to run. The water saturated the ground below and was brought to the surface by capillary attraction, perfectly accomplishing his purpose of keeping the street damp but not too wet.

The plan was finally adopted by some of the intelligent truck farmers in that vicinity to irrigate celery and other vegetables. Tile was substituted for wooden troughs, drain ditches were cut, into which the tile emptied, furnishing a perfect system of drainage as well as irrigation.

Mr. J. N. Whitner, of that city, says that to enable one

(Continued on Page 797.)

THE PRIMER OF HYDRAULICS*

By FREDERICK A. SMITH, C. E.

Applied Problems. 1. Find the depth of a rectangular box if the width is 5 ft. the length 8 ft. and the volume equals 82 cubic ft. Solution: In formula: $d = \frac{v}{bl}$. Substitute the given quantities: $d = \frac{82}{5x8} = \frac{82}{40} = 2.05$ ft.

2. Find the breadth of a box containing 100 cubic ft. if the depth is 2½ ft. and the length 16 ft.:

Solution: In formula: $b = \frac{v}{ld}$. Substitute the given quantities: $b = \frac{100}{16x2.5} = \frac{100}{40} = 2.5$ ft.

3. Find the length of a box containing 1 gallon (231 cubic inches) if the depth is 4 in. and the breadth is 5 in.

Solution: In formula $l = \frac{v}{bd}$ substitute the given quantities, then: $l = \frac{231}{5x4} = \frac{231}{20} = 11.55$ inches.

This shows the usefulness of formulæ to solve practical problems.

Article 3. Geometrical Principles.

1. *Introductory.* The science relating to the forms or shapes of things regardless of the substances enclosed is called *Geometry.* Elementary conceptions in geometry are *points, lines, surfaces and solids.* A point has no extention or size, but merely denotes location in space. A geometrical line has no breadth or thickness, but possesses *length.* A surface has no thickness, but has length and width, and a solid has length, breadth and thickness. All geometrical quantities are within *space,* which is everywhere and which is infinite. All geometrical figures drawn in a plane surface belong in the field of *plane geometry,* and all geometrical figures lying in more than one plane are part of *solid geometry.*

2. Angles and Triangles.

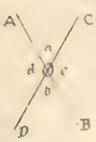


Fig. 4.

When two straight lines, AB and CD, intersect each other as shown in Fig. 4, they form *angles* with each other; let O be the point of intersection, then there are formed four angles. Angles are designated by naming three points like AOC, which angle includes the space bounded by AO and CO. The point O is called the vertex, and AO and CO are called the sides or legs of the angle; these sides must be considered of infinite length, so that the size of an angle is not affected by the length of its sides; sometimes angles are expressed also by writing a letter into the angle area near the vertex like a, x, α, β, etc. This simplifies the work many times; thus, if we set for angle AOC the letter a and for angle BOD the letter C, for angle BOC the letter c, and for angle AOD the letter d, then it is much easier to refer to any one of the angles. Angles in the position of a and b are called vertical angles, the legs of the one being extensions of the legs of the other; likewise c and d are vertical angles, and the first important principle in geometry is that vertical angles are equal; thus angle a = angle b and angle d = angle c. While angle a angle b and angle c = angle d, it is seen that there is much difference between angles a and c and means are provided to compare different angles together by measuring them with a unit angle in the following manner:

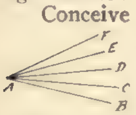


Fig. 5.

Conceive the whole plane divided into 360 equal angles, as indicated in Fig. 5, all radiating from the same point A like BAC, CAD, etc., then each of these angles is called 1 degree (1°). Each degree is again divided into 60 equal angles, called minutes (′), and each minute is divided into 60 equal angles called seconds (″); thus the whole plane measures 360°, or 21,600′, or 1,296,000″, so that by using these units any angle may be exactly expressed in degrees, minutes and seconds.

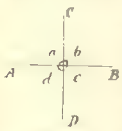


Fig. 6.

If two lines intersect each other so as to make four equal angles as in Fig. 6, in which the four angles formed are equal, $a = b = c = d$, then each angle equals $360 \div 4 = 90°$. Such angles are called right angles, and the lines forming them are said to stand perpendicular to each other; thus the line AB stands perpendicular to the line CD in the point O. An angle smaller than 90° is called an *acute* angle, like angle ABC in Fig. 7, and an angle greater then 90° is called an obtuse angle, like angle DEF in Fig. 8. If the sum of two angles equals 90°, like angles a and b, in Fig. 9, they are called *complementary* angles, and if the sum of two angles like c and d, in Fig. 10, is equal to 180°, they are called supplementary angles.


Fig. 7.


Fig. 8.

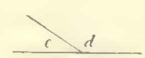


Fig. 9.


Fig. 10.

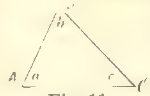


Fig. 11.

A geometrical figure bounded by three intersecting straight lines is called a *Triangle.* Thus, in Fig. 11, ABC is a triangle. Each triangle has three sides and three angles. The sum of the three angles of every triangle equals 180°; thus, if a, b and c are the three angles in the triangle ABC, then $a + b + c = 180°$. Therefore, if two angles are known in any triangle the remaining angle can be found; for instance: Angle $a = 70°$ and angle $b = 80°$; find angle c. Solution: $a + b + c = 180°$; substitute known values for $a + b$:

$$70 + 80 + c = 180.$$
$$150 + c = 180.$$

Subtract 150 from both sides:

$$c = 180 - 150.$$
$$c = 30°.$$

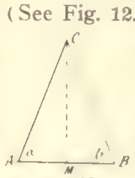


Fig. 12.

If in a triangle, two sides are equal, it is called isosceles (See Fig. 12.) If $AC = CB$, and if the line CM is drawn so that $AM = BM$, then the line CM divides the angle ACB in two equal parts and stands perpendicular to AB at point M.

If in a triangle two sides are equal, the angles are also equal opposite their equal sides. Thus, if $AC = CB$, in Fig. 12, then angle b = angle a.

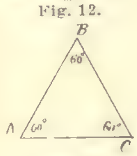


Fig. 13.

If in a triangle the three sides are equal to each other is is called an *equilateral* triangle, as in Fig. 13. If the side $AB = BC = AC$, then the angles must also be qual, hence angle a = angle b = angle c, and such a triangle is also called *equiangular,* so that an *equilateral* triangle is also *equiangular.*. Furthermore, since the sum of the three angles of every triangle equals 180°, then in the equiangular triangle each angle must be $180 \div 3 = 60°$. So, if the three sides in a triangle are equal, it tells at once that each angle in the triangle equals 60°, and if each angle in a triangle equals 60° it shows that the three sides are equal to each other.


Fig. 14.

If in a Triangle ABC, Fig. 14, the angle $ABC = 90°$, it is called a right angled triangle, and the side AB opposite the right angle, is called the Hypothenuse; hence, both of the other two angles must be acute angles, and as their sum makes 90°, they are also complementary angles.

In any triangle the sum of two sides is greater then the third side.

In a right angled triangle the square of the Hypothenuse is equal to the sums of the squares of the other two sides. Thus, if in Fig. 14 $AB = 4$, $BC = 3$ and $AC = 5$, then $5^2 = 4^2 + 3^2$, or $25 = 16 + 9$. This is a very important principle and is referred to as the forty-seventh problem of Euclid. The fact that the three dimensions, 3, 4 and 5, or multiples thereof form right angled triangles, is made use of to plot right angles as follows: Suppose it is required to draw a perpendicular at point B to the line BC; let $BC = 30'$, then AB must be 40′ and AC must be 50′ to make the line AB stand perpendicular to BC; a closed string 120 feet long with knots 30, 40 and 50 foot apart would set out a right angle anywhere; also, smaller dimensions, for instance, 15′, 20′ and 25′, or 9′, 12′ and 15′ will do the same.

3. Parallels and Quadrilaterals.

A figure bounded by four intersecting straight lines is called a Quadrilateral; thus, *ABCD*, in Fig. 15, is a quadrilateral; it has four sides and four angles; a line like *AC* is called a *diagonal*; this diagonal cuts the quadrilateral into two triangles which shows that the sum of the four angles of any quadrilateral equals 360° (two triangles).

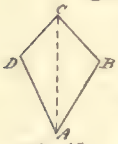


Fig. 15.

If two lines, *AB* and *CD*, are cut by a third line *EF*, so that the sum of the inner angles $a + b = 180°$, then the lines *AB* and *CD* are called parallel, which means they will not intersect each other no matter how far they are extended. It is easily seen that angle a = angle c, and angle b = angle d as well when *AB* and *CD* are parallel.

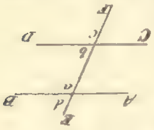


Fig. 16.

If in a quadrilateral the opposite sides are parallel it is called a parallelogram; thus, if in Fig. 17, *AB* is parallel to *DC* and *AD* is parallel to *BC*, then *ABCD* is a parallelogram and the opposite sides are equal; also, the opposite angles are equal; hence, $AB = DC$ and $AD = BC$; also, angle a = angle c and angle b = angle d; furthermore, if the two diagonals are drawn, *AC* and *BD* (See Fig. 18), intersecting in *O*, then $AO = OC$ and $BO = DO$, which means the diagonals bisect each other.

Fig. 17.

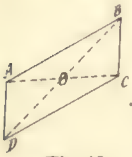


Fig. 18.

If each angle in a quadrilateral equals 90°, then it is called a rectangle or oblong (See Fig. 19.) All the properties of the parallelogram belong to this figure as well, and it has one special feature which is, that the diagonals in a rectangle are equal. Thus, $AC = BD$. This principle is made use of to test rooms or other rectangular areas to see whether they are square; for instance, let *ABCD* represent a room and let it be tested if it is square; take a string from the corner *A* to corner *C*, then take same string and stretch it from *B to D*; the string will fit both ways if the figure is a rectangle; if not, proves that the corners are not right angles. If in a rectangle all the sides are equal, it is called a square; thus, if in Fig. 20, $AB = BC = CD = AD$, then the figure is a square; all the properties of the rectangle apply also to the square with this additional one that the diagonals *AC* and *BD* intersect each other under right angles, and that the angles formed by the diagonals with the sides of the square are all 45°.

Fig. 19.

Fig. 20.

If in a parallelogram all the sides are equal it it called a *Rhombus*. Thus, if in Fig. 21, $AB = BC = CD = AD$, the figure is a Rhombus, and all the properties of the parallelogram apply to this figure with this one addition, that the two diagonals *AC* and *BD* stand perpendicular to each other.

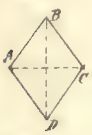


Fig. 21.

If in a quadrilateral two sides are parallel, but the other two are not, like in Fig. 22, it is called a *trapezoid*, if *AB* and *DC* are parallel and the middle point *M* of *AD* is connected with the middle point *N* of *BC*, then the line *MN* is parallel to *AB*, and *CD* and $MN = \dfrac{AB + CD}{2}$

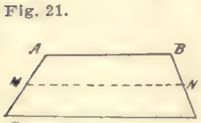


Fig. 22.

4. Mensuration of Polygons.

Any geometrical figure bounded by straight lines is called a *Polygon*. Any such closed figure embraces a certain part of the plain surface called area. Areas are measured by some unit area, which is the square whose side is the unit of length; thus, a square whose side is an inch, is called a square inch; the square whose side is 1 foot, is called a square foot; the square whose side is 1 meter long, is called 1 square meter, etc. If thus, one polygon is found to contain 8 square inches and another contains 16 square inches, then the former is half the size of the latter.

It is evident, that in a rectangle 2 inches wide and 4 inches high (See Fig. 23), the area will be 8 square inches, because by drawing the lines *EF*, *GH*, *JK* and *LM* from the inch points parallel with the sides of the rectangle the figure is cut into 8 equal squares, each equal to 1 square inch; hence, the area of a rectangle is found by multiplying the base *AB*, by the height *BC*. The area of a parallelogram is found also by multiplying the base by the height, but care must be taken to take the height correctly. Thus, in Fig. 24, if *AB* is taken for the base, then *EF* is the height, which is the perpendicular distance between *AB* and *CD*; if *AD* is taken as the base, then *GH* must be taken as the height.

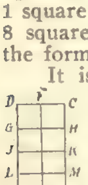


Fig. 23.

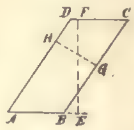


Fig. 24.

Any parallelogram can be divided into two equal triangles, as in Fig. 25, where the line *AC* divides the parallelogram *ABCD* into two equal triangles *ABC* and *ADC*, so each triangle is equal to half of the area of the parallelogram. Let *CE* be the perpendicular distance between *AD* and *BC*, then the area of the triangle $ACD = \dfrac{AD \times CE}{2}$, which gives the rule that the area of a triangle is found by multiplying base by height and divide by 2. Let in Fig. 26, the length of the three sides be a, b and c respectively, then each of them can be considered as base, and the right height is the perpendicular drawn to such base from the opposing vertex; if then three heights are drawn they pass through the same point *O*; let h be the height from *A* to a, h' the height from point *B* to b and h'' the height from point *C* to c, then the area of the triangle *ABC* can be expressed as follows: $\dfrac{ah}{2}$ $\dfrac{bh}{2}$ and $\dfrac{ch''}{2}$, all of which give the same area and are therefore equal; hence: $\dfrac{ah}{2} = \dfrac{bh'}{2} = \dfrac{ch}{2}$.

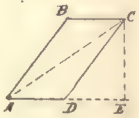


Fig. 25.

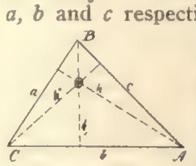


Fig. 26.

Any polygon can be divided into triangles. In Fig. 27 is shown a heptagon (seven-sided polygon), *ABCDEFG*; by drawing the diagonals *AC*, *AD*, *AE*, *AF*, the polygon is cut into five triangles and by finding the area of them and adding them gives the area of the heptagon. Let $AC = a$, $AD = b$, $AE = c$, and $AF = d$; also, the height from *B* to $a = h$, to b from $C = h'$, to $c = h''$ from *D* and *F* to $c = h'''$, and from *G* to $d = h^4$, then the area *A* of the heptagon would be expressed as follows:

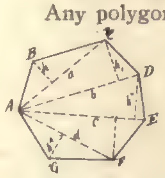


Fig. 27.

$$A = \frac{ah}{2} + \frac{ch'}{2} + \frac{ch''}{2} + \frac{ch'''}{2} + \frac{dh^4}{2}.$$

In this expression the factor ½ can be set out:

$A = \frac{1}{2}\,(ah + bh' + ch'' + ch''' + dh^4)$.

This principle can be used for any polygon.

5. Proportionality.

Things of the same kind can be compared with each other numerically; thus, if a line *AB*, in Fig. 28, is 4″ long, and a line *CD*, is 8″ long, then *CD* is twice as long as *AB*, or *AB* is ½ of *CD*; this is called a ratio. Now, let *EF* be 3″ and *GH* be 6″ long, then the ratio of *EF* to *GH* is also the same as that of *AB* to *CD*; hence, the four lines shown in Fig. 28 form two equal ratios and can be combined into the proportion:

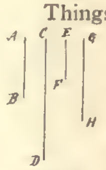


Fig. 28.

$AB : CD = EF : GH$.

(Read: *AB* is to *CD* as *EF* is to *GH*).

The four quantities are called the *terms* of the proportion; *AB* is the *First Antecedent*, *CD* the *First Consequent*, *EF* the *Second Antecedent* and *GH* the *Second Consequent*. In reality a proportion consists of two equal fractions. As above $AB : CD = 4/8$, and $EF : GH = 3/6$, or $4/8 = 3/6$.

The principal rule relating to proportions is that the product of the two extreme members is equal to the product of the middle (mean) members; so, if $3 : 6 = 4 : 8$, then

$3 \times 8 = 6 \times 4$.

This rule is used to find an unknown member in a proportion; for instance, in Fig. 28 let the length of the line *CD* be unknown and let it $= x$; then

$3 : x = 4 : 8$

form the product of the mean and extreme members;

$4\,x = 24$;

divide both sides by 4 gives $x = 6$.

(Continued on Page 798.)

ARID AGRICULTURE

BY

B. C. BUFFUM, M. S.

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Grains.

Barley is a valuable and important crop for the arid region. Our bright sunshine and dry climate gives all our grains superior whiteness and clean appearance. Barley should be more generally raised in the West as an export grain crop. In Europe white brewing barley is used for making the pale ales and in our breweries in this country much of the Eastern barley must be bleached before it is suitable for the manufacture of beer. Barley produces heavier yields than wheat and usually sells for better prices. It is a short season crop and one which is of great value for stock-feeding purposes. The farmer in considering barley has unpleasant thoughts because barley beards are troublesome to man and beast. Perhaps barley has more distinct types of grain and growth than any other cereal. There is winter barley and spring barley; there are bearded brewing barleys with two-rows, four-rows and six-rows. There are bearded six-row barleys which are hulless. There are beardless hulless barley and beardless two-row and six-row barleys which retain their hull. The color of brewing barley is white, blue and black, and the color of hulless barleys ranges from purple through the blues and greens to cream white.

Prof. B. C. Buffum.

This barley has not been very largely used in the arid region. It is one of the most valuable, however, for drouth resistance and for raising at our highest altitudes where farming is practiced. This barley produces a large head, a long, strong beard nnd large plump grain and a comparatively soft straw. It must be threshed and the grain is valuable for feed.

There are several bearded hulless barleys which are valuable grain. The principal one is the blue or purple hulless. This barley is very heavy and at St. Louis a sample from Wyoming weighted sixty-seven pounds per bushel, being the heaviest grain on exhibition from any part of the world. The most generally grown hulless barley is the "Bald" or "Beardless barley." This is a six-row grain with the beards aborted into a curl or three-cornered scale on the top of the grain. The principal objection to this barley is that the heads are carried on very weak straw, and if allowed to get too ripe there is considerable loss by their breaking off in the field or in handling. Another objection to all of the hulless barleys is their hardness. The grains are so compact and hard that it is almost impossible for animals, even with good chewing teeth, to grind them, and to feed successfully they must be either cooked, soaked or ground.

The best brewing barleys we have grown at high altitudes and in the northern district of irrigated America are the two-row types, "Goldthorpe," "Chevalier" and "Hanna." One of the six-row types is "Mansury." There are many others now being made by breeding and selection, especially some valuable new sorts from Sweden, but they are not on the market and available so the farmer can get the seed.

There are two forms of beardless brewing barley. One is a small two-row barley net yet in general cultivation and the value of which has not been determined. The other is a larger six-row barley which, under good conditions, produces excellent growth of straw and large, well-filled heads. This is one of the most important feed grains the western farmer can produce, whether he dry farms or irrigates his land. The straw is soft, sweet and nutritious. The grain can be cut in the dough stage and fed to stock in the bundle without threshing. There are no beards, and stock fed a ration of this barley in the straw, and alfalfa, seem to thrive and fatten remarkably well. The objection to this barley is that of the other beardless sorts. The heads become brittle and break off or shatter in handling when it gets too ripe.

Many complain that they do not get as good crops of barley as they have a right to expect. This is generally because they do not follow the correct method of culture. Barley needs a large amount of moisture in the early part of its growth. It needs a goodly supply of available nitrogen in the soil. If these things are absent the barley injures very quickly. Its tendency, when injured by drouth or lack of plant food, is to make very short straw and small, poorly-filled heads. Barley does not show its injury by drouth as do other grains by burning and shriveling up. Before the farmer knows it his barley field may become too dry and subsequent irrigation does not make it recover as it will oats or wheat. Barley soil should be prepared in the fall or irrigated before plowing in the spring. The soil should be watched and if getting dry, even when the plants are very small, irrigation should begin. If the plans are kept moist until the barley is well headed, irrigation may stop and a good crop will be secured. Barley may be planted on new soils or, better, on soils which have been in rotation, following potatoes, peas or alfalfa.

Oats are the first and most general crop raised by the arid farmer. Farmers know more, perhaps, about this grain than any other. Oats are one of the best crops to raise on sod. They always find home use as feed for teams or other stock, and there is usually a good market for the surplus. Oat culture is as simple and easy as that of any of the grains. Early varieties will mature with comparatively little moisture, but they respond to frequent irrigation and much better water than other grains. Oats on sod land may be irrigated every week or two and when they are high enough to begin to shoot, they should be thoroughly soaked by a complete irrigation.

Perhaps the best drouth resistant variety for general cultivation is the Kherson or the Swedish Select. Some most excellent short-season varieties also are Scottish Chief, Lincoln, Black Beauty, Big Four and Clydesdale. The best yielding varieties are those which take the longer season to mature. The White Russian side-oat has produced heavier yields, perhaps, than any other in general cultivation.

Wheat is one of the most important grain crops for the western dry farm and has its place in crop rotations under irrigation. The average yield of wheat in the arid region approximates twenty-five bushels per acre. In round numbers this is twice the average yield of the humid states. Good farmers, however, are not satisfied with yields of less than forty or fifty bushels per acre. Wheat should give a net profit, over and above the expense of producing it, of from twelve to fifteen dollars per acre.

Wheats succeed best on heavier soils, providing they have good drainage and do not contain too much alkali. Light soils are not so favorable for wheat, but under dry farming loamy soils which are somewhat more retentive of moisture will give best results. Our soils are sufficiently rich in mineral plant foods, the only fertilizing needed being tillage and rotation with peas, alfalfa or potatoes. Wheat ought never to follow others grains, and there should seldom be raised two successive crops of wheat on the same land.

Wheat succeeds much better in a well compacted soil. Fall plowing or early spring plowing will usually give best results. Under irrigation deep plowing is not so necessary or advisable as it is for other crops. The land should be harrowed to form a good seed bed and save moisture.

There are a large number of varieties of spring wheat which may be successfully grown in the West. In Utah, eastern Oregon, Washington and in the Southwest, the square head wheats or club wheats are grown because they do not shell out and may be allowed to get fully ripe in the field so they may be harvested with combined harvesters and threshers, or headed and taken at once to the threshing machine. In the northern portion of the mountain region the Fife and Blue Stem, known as Northern Hard wheats are the best milling sorts. For the southern half of this region wheats of the Defiance type or White House are the leading varieties. For dry farming the most successful and valuable spring wheat is the Kubanka type of Durum wheat. For feeding pur-

poses, the Macaroni, Polish, and Egyptian wheats are valuable drouth resistant kinds. As yet there is only one variety of winter wheat which can be recommended for general planting. This is Turkey Red, which is a fine milling wheat. and succeeds under both systems of dry farming and irrigation. Karkof winter wheat is being tried and so far all reports are most favorable. The Silver King, which is a beardless winter wheat, has succeeded fairly well in some sections of the West.

Seed wheat should be plump, heavy, true to type, clean, free from weed seeds or other grain, and treated for smut. (See Chap. 18.) The average amount of seed to use per acre on irrigated farms is about seventy pounds. Of the larger standard kinds, like Macaroni or Polish wheat, ninety to one hundred pounds may be used, and for dry farming, thirty to forty pounds of seed per acre. These figures are good average amounts to use if sown with a press drill. If necessary to sow broadcast a third more of seed should be used. On rich lands with rotation and irrigation, only thirty pounds of seed per acre of spring wheat gives maximum yields.

The time to sow wheat is as early in the spring as the ground can be prepared and when danger of hard freezing of the soil is past. The seed should be drilled two or three inches deep. Winter wheat may be sown any time in September if the ground is moist and the seed bed well prepared. If the land slopes so much that it washes badly, the drill should be along the hill instead of straight up and down it. so the growing plants will check the force of water.

There should be sufficient moisture in the soil to secure seed germination and to supply the plants until they become well established. If the ground is dry and there is not sufficient spring rain, the land should be irrigated before the wheat is planted. The plants should not be allowed to suffer for water, but on the other hand, it is better not to irrigate them until they are five or six inches high or large enough to partially shade the ground. Short, quick irrigations, which soak the ground pretty well are better than allowing the water to run too long. Generally, irrigation should be given when the plants begin to shoot, that is, when the first stems begin to be thrown up. Another irrigation should be given after the heads are formed to insure large heads and filling of the grain. If the weather is very dry and hot, care must be taken with late irrigations of wheat, because if kept too wet at this time it might induce rust to cause considerable damage. Where the straw is badly rusted it seldom produces plump wheat and if rust is present it is probably better to keep the water off. Some farmers in the southwest believe that the shattering of the grain may be largely prevented by giving late irrigation. This is true because the grain does not get so ripe. In many cases late irrigation may result in damage by frost.

Wheat should be harvested before it gets too ripe. Experience indicates that the best results are obtained by cutting wheat in the last part of the dough stage. Such grain usually ripens in the straw and makes heavier seed. Harvesting early prevents loss by shattering. East of the mountains it is well to allow the bundles to stand in the shock for some time to go through the sweat and dry out before stacking.

If properly fed wheat has been shown equal to corn for fattening stock. Some successful feeders in the West head their wheat and feed it to stock without threshing. This is one of the best methods of feeding wheat, as it is not so apt to throw animals "off feed." as giving them the cleaned grain. Some of the beardless wheats may be fed in the bundle. Bearded sorts will need to be threshed.

Rye is not appreciated as it should be. In the West, rye is not raised to any extent for the production of flour. There is some prejudice against rye as stock food. There is, perhaps, no more valuable grain for the feeding of swine than rye and it should be more generally raised for this purpose. Rye hay is of much value in some sections. When raised for hay it should be planted thick and cut when in the milk or early dough stage. The winter rye is one of our most hardy grains and one of the most important ones for the dry farmer. It succeeds in almost any part of the arid region, and on new dry farm lands produces over forty bushels per acre as a maximum crop. Rye sometimes lives several years and produces a number of crops with one planting if cut in its early stages.

Rye may be planted early in the fall, the last of August or any time during September, and the young growth may be used for pasturing stock either in late fall or early spring. The ground should be well filled with moisture before the rye is planted, but this crop will stand winter drouth and cold. It should be harrowed one or more times in the spring and if water can be had for irrigation and there is not abundant rainfall, it should be irrigated about twice. The first irrigation should be a thorough soaking when the rye is in the "boot" or begins to "shoot.' The last irrigation may be given when the rye is in the early dough stage to fill it and make an abundant crop. Rye will grow on poorer soils than any other grain, and even under most adverse conditions will give some kind of crop. As yet there are no improved varieties of rye on our markets. This grain has been bred to great perfection in parts of Germany, where single farmers have devoted years to grading and adapting special strains of rye for their localities and soils.

De Candolle believes that Spelt was the corn, **par excellence** of Pliny, which he said was used as food by the Latins for 360 years before they knew how to make bread. It has been cultivated principally in Germany. where it is called Spelz or Dinkel. Spelt, or Emmer, is one of the primitive forms of wheat, but resembles barley in character, as it is bearded and the grain is held tightly in the chaff, little or none of it shelling out when it is threshed. Spelt is receiving much attention in this country as stock food. Much is being claimed for it as a drouth-resistant grain. The North Dakota Experiment Station reported that Spelt produced heavy yields, especially good results being obtained with home grown seed.

Analyses made at the South Dakota Experiment Station shows a composition resembling that of barley. The spring spelt should yield from twenty-five to seventy-five bushels threshed grain per acre. A new spelt has been introduced and is being increased and improved, by breeding, in Wyoming. This is called Black Winter Emmer and differs from the ordinary spelt in its season of growth, color, hardiness and yielding quality. It is a winter grain of great importance, as winter grains are more valuable to the dry farmer.

In Dakota it has been found that spelt fed to steers produced as good quality of meat as corn. It took one and one-fourth pounds of spelt to equal one pound of corn in steer feeding. In feeding beef during a grass period, however, it took only 5.16 pounds of spelt for one pound of gain and at the same time it took 7.03 pounds of corn for one pound of gain. With baby beef feeding it took 1.84 pounds of spelt to 1.69 pounds corn. to produce one pound of gain.

In my own experiments with lamb feeding in Colorado a high value was shown for spelt. The lambs eating spelt consumed more of both grain and alfalfa hay than those which were fed corn.

The following tables give a brief statement of the results:

LAMB FEEDING TRIALS.

Feed.	Amt. of feed eaten. Grain pounds	Alfalfa pounds	Grain eaten for 1 lb. Gain pounds
Spelt	430	889	3.03
Corn	402	803	3.09
Barley	402	888	3.43

THE GAINS AND COST OF GAIN.

	Gain of Wool pounds	Gain of Meat pounds	Total gain pounds	Cost per lb. of gain cents
Spelt	15	127	142	4.28
Corn	17	113	130	5.25
Barley	20	97	117	4.95

These experiments show a high feeding value for spelt. When we consider that spelt will yield from a third more to twice as much as corn; that it is a drouth-resistant grain, and that it is better suited to a cool climate or one with cool nights than corn, its value in the arid region becomes apparent.

Notes on Practical Irrigation

D. H. Anderson

Laying Out of the Land—Method of Planting.

Generally speaking every farmer has his land under his eye and knows what to do with particular portions of the ground. He will plant wheat in this field, barley over yonder, further along he expects to have a patch of rye.

In the case of vegetables he follows the same practice and plants his cabbages, his beets, turnips, etc., whereever the fancy moves him. It is a haphazard manner of farming, and to it may be atributed failures which have been ascribed to the elements. From what has been heretofore said it must be apparent that there is something in soil and in the manner of planting which it would be well to heed; indeed, which must be heeded if success be desired and a crop assured. True, plants will grow if the seed be thrust in the ground; that is, after a fashion; and so will an animal grow if kept alive after a fashion, but the produce in both cases will be scrub.

Irrigation Age. Correspondent Meets with Mishap—Swins Ashore.

The time is coming, if it has not already arrived, when farmers will be able to produce as much from half an acre of ground as from an acre, and better crops. Too much land is as great a bar to success as too little, for in the former case there is too much trusting to luck, whereas in utilizing nature for the purpose of wresting products from the bosom of the earth there is not the smallest element of luck; it it all pure science, knowledge, ability, etc. A man with a trifling commercial business keeps an account of stock, his books show just what he has on hand, his sales and purchases. His inventory shows where his varieties of goods are located on his shelves. But when it comes to a farm, which is never a small business, no books are kept, no account of stock taken, and the location of his crops are retained in his mind's eye. More than that, quality is little regarded, the varieties of soil are not considered, and plants requiring one kind of soil are fed on a kind they do not flourish in. This is the common rule.

Take any tract of land, large or small, and when the crop is growing there will always be spots where the plants are thin, sparse and sickly. Failure of proper cultivation? Not at all; nothing but failure to properly lay out the land so as to know what it is suitable for. The pollen of a sickly plant spreads as far as that of a good healthy one, and poor results are attributed to poor seed, etc., when a little care and forethought might have made the crop uniform and the results satisfactory.

This is preparatory to the subject of laying out the land, for upon doing that properly depends the success it is always desirable to attain in every species of farming for profit. If profit be not the desideratum, then why go to the trouble and labor of farming?

The proper laying out of the land is always of great importance, and where irrigation is practiced it is of the highest importance. Water runs down hill and it also soaks into the soil seeking the water table, and this water table is always receiving additions, through the constant or periodical application of irrigation water, and rises to do damage.

Hence drainage is to be considered as well as the slope of the land. The first thing to be done is to prepare an outline of the land, its boundaries. If a square tract the matter will be easy, for any sized square may be laid down upon paper and then measured off into acres or parts of acres to suit the convenience. A map of one's land is a necessity nowadays, and it is not difficult to prepare one. It is the farmer's diagram of the location of his stock, equivalent to the shelves in a store of merchandise. It tells him the location of his crops, the nature of the soil, his ditches, and all their ramifications, and if anything goes wrong he can immediately put his finger on the point of trouble and go at once to correct it.

To prepare a map of the land measurements must be taken, and these measurements are expressed in tables universally adapted and can therefore always be relied upon as uniform. To begin with, an acre of land, whatever its shape, contains nearly 43,560 square feet, and after an outline has been traced upon paper, lines may be drawn from side to side and these lines crossed by other lines drawn from top to bottom. The map will then be covered with little squares which may be any part of an inch in size, but representing a given quantity of land; say one inch square on the paper represents an acre of ground; then if you have a farm of 100 acres your map will be ten inches square, if the land is a square, but whatever the shape of the land it will contain exactly 100 square inches. Not a very large map, but very convenient, for on it may be expressed the exact location of crops, even to a small cabbage patch, ditches, farm buildings, orchards, vines, etc., etc. Of course any scale to the acre may be selected instead of one inch. If the farm is large then make the scale one-half inch to the acre or even less, or if small make the scale two inches or more, to allow of the least details.

If it is desirable to make an accurate estimate of the amount of land in different fields under cultivation, the following table will be of assistance:

10x 16 rods equals 1 A.	70x69.5 yards equals 1 A.
8x 20 rods equals 1 A.	220x198 feet equals 1 A.
5x 32 rods equals 1 A.	440x 99 feet equals 1 A.
4x 40 rods equals 1 A.	110x369 feet equals 1 A.
5x968 yards equals 1 A.	60x726 feet equals 1 A.
10x484 yards equals 1 A.	120x363 feet equals 1 A.
20x242 yards equals 1 A.	240x181.5 feet equals 1 A.
40x121 yards equals 1 A.	200x108.9 feet equals 1 A.
80x60.5 yards equals 1 A.	100x145.2 feet equals 1 A

100x108.9 feet	equals ¼ A.
25x100 feet	equals .0574 A.
25x110 feet	equals .0631 A.
25x120 feet	equals .0688 A.
25x125 feet	equals .0717 A.
25x150 feet	equals .109 A.
2178 sq. feet	equals .05 A.
4356 sq. feet	equals .10 A.
6534 sq. feet	equals .15 A.
8712 sq. feet	equals .20 A.
10890 sq. feet	equals .25 A.
13068 sq. feet	equals .30 A.
15246 sq. feet	equals .35 A.
17424 sq. feet	equals .40 A.
19603 sq. feet	equals .45 A.
21780 sq. feet	equals .50 A.
32670 sq. feet	equals .75 A.
34848 sq. feet	equals .80 A.

In measuring land there are three distinct operations to be performed: Taking the dimensions of the tract; delineating or laying down the same on a map, and calculating the area or superficial contents. All the tables applicable to land measurements will be found in the Appendix, to which the reader is referred.

For ordinary purposes a knotted cord or tape-line may be used. In measuring a simple figure, as a square field, nothing is necessary but to measure the length and the breadth, which, multiplied together, will give the superficial

area. Where fields are irregular shaped, it is necessary to adopt some standard guiding form, and from that measure the different angles, so as to be able, from the dimensions taken, either to calculate the contest at once, or to lay down the form of the field on paper according to the scale adopted, and from that ascertain its dimensions and calculate its contents.

The simplest and most accurate mode of ascertaining the contents of all irregular shaped figures is to throw them into triangles, and this method is usually employed whether a small piece of irregular shaped land is to be measured or a vast extent of territory. To find the contents of a triangle all that is necessary is to multiply half the perpendicular by the base. And this regardless of the shape of the triangle. In measuring land in this manner, and by a little calculation, every foot of land can easily be represented on paper.

Taking the Level.

After the land is accurately measured, or measured satisfactorily to its owner, taking the level of its surface is the next thing in order, and in this there can not be too much care taken, particularly where the irrigation is practiced. Upon it depends the proper flow of water in ditches, the flooding of land and adequate drainage.

To explain it will be necessary to be a little abstruse, but the idea will be readily grasped by thinking. The earth is a sphere, that is, "round," and all places on its surface, whether a ten-acre tract or one of ten thousand, are said to be "level" when they are equally distant from the center of the earth, and "out of level" when their distances from that center are not equal.

Now, because the earth is a sphere, or round, every level line drawn upon its surface from one point to another, must be a curve and part of the earth's circumfenrence, assuming it to be perfectly smooth, or at least parallel with it.

The common methods of leveling are sufficient for irrigation on an ordinary tract of land, but for long canals and ditches miles in extent, the leveling must be in accordance with the curved level line to correspond with the surface of the earth equi-distant from its surface. The usual instrument for leveling is the road or mason's level with telescope and compass, the latter to get the bearings. For ditching purposes a "plumb-bob" level, a two-legged contrivance open like the letter A with a line fastened at the top and terminating in a pear, or "top" shaped piece of lead. In the exact center of the bar across the A is marked a notch, and when the point of the "bob" is that center notch, the line is level. Illustrations of this and other contrivances for leveling land will be found elsewhere, and referred to in the synoptical index so as to be easily found.

To continue the level line a series of poles are necessary. These are so placed that the one nearest the eye conceals all the rest. To allow for inequalities of surface, a notch is cut in the starting pole, or at the point where the level line begins, and that point must be level with it all along the line. A small spirit level held to each pole, and the eye will demonstrate the exact level line for all practical purposes. This method is sufficient for small areas, to lay the level of a ditch, or its laterals, but in large tracts, of course, a surveyor should be called in. Every farmer with a hundred acres to level can easily do the whole surveying himself by following this apparently crude method, and be as accurate in his leveling as a professional surveyor.

Where there are curved lines to be drawn on irregular surfaces, a hill or a knoll, for instance, being in the way of a straight line, the mariner's compass may be brought into use to ascertain bearings, and a series of straight lines drawn which will make skeletons for the curves. In fact, it is no trick at all to draw a level line around a hill, or curve a ditch in the shape of a letter S or Z, by this simple method. All these measurements should be traced on the map, for even if not used immediately they will prove useful when necessary to ditch, or irrigate.

The following table showing various grades per mile will be useful as a basis of calculation in drawing the level lines for ditches or general irrigation purposes:

1 foot	in	15	is	352	feet	per mile
1 foot	in	20	is	264	feet	per mile
1 foot	in	25	is	211	feet	per mile
1 foot	in	30	is	176	feet	per mile
1 foot	in	35	is	151	feet	per mile
1 foot	in	40	is	132	feet	per mile
1 foot	in	50	is	106	feet	per mile
1 foot	in	100	is	53	feet	per mile
1 foot	in	125	is	42	feet	per mile

Any desired grade or "flow" can be calculated by remembering that there are 5,280 feet in a mile. By dividing 5,280 feet by the number of feet in length of the ditch, the grade or "fall" will be the result, estimating one foot as the desired fall or flow of the water in the ditch, and the desired fall or flow may be regulated when drawing the level line by notching the poles used in leveling.

Elementary Information.

To make this land leveling business clear to the mind of the elementary reader, let it be supposed that he desires to run a ditch from one point to another. He has the letter A-shaped plumb-bob leveler, half a dozen poles ten feet or so in length, and a carpenter's spirit level. With these he is prepared to run practically level lines all over a hundred-acre tract of land.

At the starting point ascertain the "plumb" point, that is, the spot over which hangs the lead bob exactly in the middle of the cross-bar of the A, then plant a pole, and at the height of the eye, say five feet, cut a plainly visible notch, or make any kind of a mark that can be seen from a distance. This is the standard of the entire ditch.

Next, take another pole, your A level, and the spirit level, and walk along the proposed line of ditch any convenient ditsance to a point. Four rods or so are not too far, less if there are obstructions to level around. Lay the A level over the selected point and ascertain the exact level of point two, as it may be called. Now place the spirit level against the pole about the height of the eye, and look along its top just as if "sighting" a gun. Slide it up and down, if necessary, until you find the notch in the first pole, with the "bubble" in the spirit level exactly in the center, and make a notch or mark in pole number two where the top of the spirit level touches it.

A calculation is easily made, for the notch on pole one is five feet from the surface of the ground, and by measuring the height from the ground of the notch in pole number two, any variation will mean that another level point must be selected, or that there must be some grading or digging.

The second level point having been established, proceed with the third pole in the same manner, comparing it with the second pole, carefully noting the figures on paper, and so continue until the work is completed. Laterals may be run in the same manner, and the entire parcel of land gone over, the results in figures showing the slope or lay of the land for every purpose. This leveling, if carefully and completely done, will show numerous grades, or slopes in the same parcel or tract of land, and the knowledge of this is extremely valuable; in fact, necessary for irrigation purposes, whether ditching or flooding. It is often a very intricate matter to irrigate every portion of a given field uniformly, and failure to do so always results in lack of uniformity in any crop sought to be grown upon it, there being too much water on some parts and not enough on others. It will be understood that the waste of water and the loss in crop must exceed by far the expense of leveling the land in every direction. The chapter on irrigation will give details of flowing water on irregular surfaces, and reference to the synoptical index will point out comprehensive illustrations.

Before concluding this portion of the chapter on "Laying Out of Land," it is proper to add by way of information, that on July 28, 1866, the Congress of the United States legalized what is known as the "metric" or French system of measurements, and provided that "It shall be recognized in the construction of contracts..*..*..*..*..as establishing in terms of the weights and measures now in use in the United States, the equivalents of the weights and measures in common use."

That portion of the "French" system relating to land measurement is given here, in case any farmer should fancy it in preference to the "English" system, which has always been used:

Measures of Length.

Metric Denominations and Values.		Equivalents in Denominations in Use.
Myriametre	10,000 metres	6.2137 miles
Kilometre	1,000 metres	0.62137 mile, or 3,280 ft. 10 in.
Hectometre	100 metres	328 feet 1 inch
Dekametre	10 metres	393.7 inches
Metre	1 metre	39.37 inches
Decimetre ..	1-10 of a metre	3.937 inches
Centimetre..	1-100 of a metre	0.3937 inches
Millimetre..	1-1000 of a metre	0.0394 inch

Measures of Surface.

Metric Denominations and Values.

Hectare	10,000 sq. metres	2.471 acres
Are	100 sq. metres	119.6 sq. yards
Centare	1 sq. metre	1,550 sq. inches

This metrical, or decimal, system is not in common, everyday use; on the contrary, it is rarely found except in Government reports.

The matter of fencing should not be omitted in this place, and so estimated quantities in the convenient barbed wire fencing are here given. The table gives an estimate of the number of pounds of barbed wire required to fence the space or distance mentioned, with one, two or three lines of wire, based upon each pound of wire measuring one rod (16½ feet):

	Pounds.	Pounds.	Pounds
1 side of a square mile..	320	640	900
1 rod in length.........	1	2	3
100 rods in length........	100	200	300
100 feet in length.........	6 1-16	12⅛	18 3-16

Method of Planting.

It must not be supposed that this part of the present chapter will exhaust the subject of methods of planting. The subject is too large and important to be treated in one place, and it is therefore distributed in other chapters to follow. But it is all important to consider the nature of the plant which it is purposed to grow, and plant the seed in such manner that it will have room to grow and develop its seed or fruit. If the previous chapters have been carefully read the reader will remember that great stress was laid upon the fact that all plants are great feeders, and that they are so by instinct, and to attempt to compel them to abstain from their proper food, or limit their food supply on the ground of economy or indifference, or upon the supposition that they will grow anyhow, is to reduce the product of that plant proportionately. It is always a losing plan to restrict the food of plants, for that means stunting their growth.

Now, whether the seed be sown broadcast, planted in drills, or the young plant transplanted, care must be taken that the roots have space to spread, or reach out for the required food. If they have not then they rob each other and fail to produce as desired. Plants are cannibalistic in their customs and must not be humored in the slightest degree.

There is a curious fact about the growth of plants which may not be out of place here, inasmuch as it will prove an addition to the reader's information concerning the peculiarities of the plant kingdom: Experiment has demonstrated that the smallest seeds, even, say the mustard or radish, sown in an absolutely sterile soil, will produce plants in which all the organs are developed, but their weight after months does not amount to much more than that of the original seed. The plants remain delicate, and appear reduced or dwarfed in all dimensions. They may, however, grow, flower and even bear seed, which only requires a fertile soil to produce again a plant of natural size.

In planting without providing room for the plant to feed, or sowing, or planting too many of its fellows in too close proximity, the soil is rendered sterile by over-consumption, and the plants starve or fail to produce adequate crops This well known fact, together with the application of the experiment above cited, will explain why, in rows of plants, there are spots where the plants do not grow to perfection so far as producing is concerned. They grow, it is true, but they are dwarfs.

There is another thing to be considered also in this connection, which is that plants are not all robust or healthy in the same degree. One may be so situated as to its environments as to be able to develop more quickly than its neighbors, in which case it will "crowd out" its neighbors, or absorb their food, which means the same thing. Just as when to humans sleep in the same bed, the healthy and vigorous one will absorb the vitality of the weaker one, a well attested circumstance in medical annals.

Experience has demonstrated beyond controversy that there is as much of a plant under ground as above it, whether that plant be a tree or a cabbage, and hence it is not difficult to gauge the proper distances in planting, if perfection of growth be the desideratum. Few, however, pay the slightest attention to this fact, and hesitate to "pick out" the superfluous plants in the radish or lettuce bed, and the consequence is they wonder why their neighbor grows such fine cabbages when they have the same soil and bestow the same care upon them. They do not give them the same care; the neighbor is economical, for he thins out his rows and gives the remaining plants room to grow. This means quality as well as perfection.

A Chinese gardener will grow vegetables so close together that they will touch, and anyone watching him will suppose that the thinning out process is not essential. But it is in his case as well as in all other cases, the only difference being, the Chinaman knowing very well that his plants will not grow if crowded together, and that they must be thinned out. But he knows the reason, and that reason is that they must have food in sufficient quantities, so he gives it to them and makes up for lack of space by supplying food. This is why the Chinaman can be seen always dosing out his plants with liquid fertilizers. He never rests, but is always at work "forcing" his vegetables to grow. Anyone can do the same, but the average American farmer, with his acres of land to the Celestial's square feet, does not deem it necessary to crowd his plants. Moreover, to speak truly, forced plants are never as substantial as those grown naturally, and this ought to be a sufficient reason for so planting that every individual plant may be surrounded by its own storehouse without encroaching upon the preserves of its neighbors.

The following table will assist the farmer in planting seed, bearing in mind always that the plant is as large under ground as above it, whether it be a tree or a cabbage. The distances are in feet, basing the calculation as 43,560 square feet to the acre:

Distances Apart.	No. of Plants.	Distances Apart.	No. of Plants.
1 x1	43,560	7x 8	888
1½x1½	19,360	8x 9	680
2 x1	21,780	9x 9	537
2 x2	10,890	10x10	435
2½x2½	6,969	11x11	360
3 x1	14,520	12x12	302
3 x2	7,260	13x13	357
3 x3	4,840	14x14	222
3½x3½	3,555	15x15	193
4 x1	10,890	16x16	170
4 x2	5,445	17x17	150
4 x3	3,630	18x18	134
4 x4	2,722	19x19	120
4½x4½	2,151	20x20	108
5 x1	8,712	24x24	75
5 x2	4,356	25x25	69
5 x3	2,904	27x27	59
5 x4	2,178	30x30	48
5 x5	1,742	40x40	27
5½x5½	1,417	50x50	17
6 x6	1,210	60x60	12
6½x6½	1,031	66x66	10

To round out the above calculation, the following table of the quantity of seeds required in planting is added:

	Seeds, per oz.	Length of Drill, per oz.	Vitality, Years.
Asparagus	1,000 to 1,200	50 feet	4 to 6
Beet	1,200 to 1,500	100 feet	6 to 8
Carrot	20,000 to 24,000	200 feet	1 to 3
Cabbage	8,000 to 12,000	Transplant	4 to 6
Cauliflower	8,000 to 12,000	Transplant	4 to 6
Celery	50,000 to 60,000	Transplant	3 to 5
Egg plant	5,000 to 6,000	Transplant	5 to 6
Endive	20,000 to 24,000	Transplant	8 to 10
Lettuce	25,000 to 30,000	400 feet	5 to 6
Okra	500 to 600	50 feet	5 to 6
Onion	7,000 to 8,000	2,00 feet	1 to 2
Parsnip	5,000 to 6,000	200 feet	1 to 2
Radish	3,000 to 4,000	100 feet	4 to 5
Salsify	2,500 to 3,000	100 feet	4 to 5
Spinach	2,000 to 3,000	100 feet	4 to 5
Tomato	About 2,000	Transplant	4 to 5
Turnip	8,000 to 12,000	200 feet	6 to 7

The quantity of seed for the space specified in the second column of the latter table is much too great, but it is the conventional quantity and is given as the maximum. In our garden culture all of the common plants mentioned are susceptible to transplanting with good results, even the onion; but, of course, in field culture chopping out with a hoe is the most advisable method to pursue in thinning.

Reclamation Notes

CALIFORNIA.

Work on the irrigation system of the Madaline Meadow Company is progressing rapidly and the canals and ditches will carry water to several hundred acres next season. A deal has been closed whereby the Madaline Meadow Company has secrued an additional water supply from the head of the south fork of the Pit River. In the Tule Lake reservoir this company has room to store water to irrigate 100,000 acres.

The San Joaquin Irrigation district has purchased a half interest in the waters of the Stanislaus River, the purchase price being $325,000. The San Joaquin Company promoters are plannin~ an immense irrigation system, the water to be taken out of the Stanislaus River, five miles above Knight's Ferry and conveyed by canal system to the corners of San Joaquin, Calaveras and Stanislaus Counties, where a large reservoir site is being surveyed. This system will irrigate 70,000 acres of land in the three counties.

Among the larger improvements mentioned in news items is an immense irrigation system located on the Piacenes ranch, twelve miles south of Hollister. The main canals were completed recently and a big dam is in course of construction. The reservoir is an extension of the present irrigation system, which irrigates the lands of Hollister Valley and is supplied with water from the Pincs and Benito Rivers by long canals, which were very difficult to construct.

Sacramento has been favored with the location as a natural site for the operations of the United States Farm Lands Company with a capital of $30,000.000 and a number of subsidiary companies; among them being the Sacramento Colonization Company with a capitalization of $3,000,000, which was financed by the Kuhn Syndicate of Pittsburgh, bankers, for $10,000,000.

An important case in the Superior Court, California, was recently disposed of when Judge M. T. Dooling awarded the heirs of the late Byron D. Beckwith a judgment against the Central Land and Irrigation Company for $50,000. The Central Land and Irrigation Company was the outgrowth of a project founded by Mr. Beckwith in 1900 to furnish water for irrigation in Glenn and Colusa Counties.

What is considered the most important single event in the history of the Imperial Valley occurred when, at a recent mass meeting of the water users of the Valley, it was decided, with but one dissenting vote, in direct opposition with water attorneys employed by the Valley, to proceed with the organization of an irrigation district under authority of the State law known as the Bridgeford Act.

The Covina Irrigation Company has decided to expend from $150,000 to $175,000 in the development of additional water, the shortage of water during the Spring season spurring the share-holders to a determination to better supply the needs of the district.

J. L. Slater and his associates are busily engaged in taking options on Elder Creek and otherwise promoting the big irrigation and colonization scheme proposed to be carried out there. It is estimated that over 50,000 acres will be brought under water by this project from the Lourie reservoir.

Irrigation systems and devices are to be features of the first National Orange Show in the world, which will be held in San Bernardino early in March 1912. It is intended to make this an annual event hereafter.

H. D. Graydon, Civil Engineer of Portland, who is also a promoter, has filed on 45,000 inches of water to be taken from the Feather River for irrigation purposes, and subsequently filed on 15,000 additional inches, which he estimates will irrigate 250,000 acres. Water is to be carried down the right bank of the stream for a distance of fourteen miles, where it will be carried across the stream by means of a siphon.

Land owners from the west side of the San Joaquin Valley gathered recently in Merced to discuss plans for the formation of a gigantic irrigation district, embracing 1,800,000 acres on both sides of the San Joaquin river and extending from the Tracey & Lathrop railroad on the north to a point two miles south of Summit Lake, a total length of 125 miles, with a width of about 50 miles.

A movement is to be started at Barstow, which will spread over all that section of the Mojave desert that depends upon the Mojave River for water, whereby the government will be asked to build an immense dam at the head waters of the stream where the thousands of inches of water now going to waste may be conserved.

To make the bonds of irrigation districts more salable assemblymen of Modesta introduced a bill in the California House creating a commission, consisting of the Attorney General, Comptroller and State Engineer, whose duty it shall be to investigate all irrigation districts about to issue bonds.

Hard Brothers, of Concord, have the contract for grading work on the distribution system, Orland irrigation project. The work involves the excavation of approximately 58,000 cubic yards of material. The contract price is $10,738.20.

COLORADO.

By combining two irrigation projects in Montrose County, water for 25,000 acres will be secured one year earlier than was expected. The Lillylands Irrigation Company met in Montrose recently and voted to accept the proposition for consolidation with the East Paradox Irrigation Company.

Unless the President, or Congress, or Secretary Ballinger reverses the recommendation of the Army Engineers, which favored the low survey for the high line canal in Grand Valley, work on that project may be held up for some time. It is said that the ranchers intend to fight the decision of the engineers, as the use of the low survey will practically annihilate the Stub, or Mesa County Irrigation District.

Important steps toward closing the contracts for the resumption of work on the irrigation system of the Denver Reservoir Irrigation Company were taken recently when an order was issued by Judge Allen in the District Court authorizing the company to close contracts with representatives of the Franco-American Bank of Paris, under which the French bankers are to furnish $2,000,000 toward the completion of the enterprise of the Henrylyn Irrigation System. Other reports state that those interested can get no better offers from the foreign bankers than may be obtained from institutions in the United States. The first information, however, reaches us through the columns of one of the leading daily Colorado papers and is likely to be found correct.

An injunction suit, in which the complainant attacks the constitutionality of the Colorado statute under which irrigation districts are organized, was recently argued in the District Court at Colorado Springs before Judge John W. Shefor. The breaking up of these districts would result in the loss of millions of dollars by the decreased valuation of lands where the districts are located. For this reason, the case is one of the most important heard in a Colorado court in years.

R. F. Millford of Grover will build a novel irrigation system for his one-quarter section, to include a reservoir, pipe line and pumping plant, securing his supply from seepage water. This water will be conducted in ditches from a covered pipe line into the Millford reservoir,

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Supreme Court Decisions

Irrigation Cases

NONUSER OF WATER—

Nonuser of an appropriation of water is not an abandonment thereof, unless the intention to abandon exists. *White* v. *Nuckolls.* Supreme Court of Colorado. 112 Pacific 329.

USE OF WATER—

Rights of a riparian owner to the use of water at common law included the right to use it for irrigation as well as for domestic purposes. *Lone Tree Ditch Co.* v. *Cyclone Ditch Co.* Supreme Court of South Dakota. 128 Northwestern 596.

CHANGE IN DIVERSION—

One suing to change the point of diversion of his irrigation ditch must show that it will not injuriously affect the vested rights of others, though this may involve proof of a negative. *New Cache La Poudre Irrigation Co.* v. *Water Supply & Storage Co.*, Supreme Court of Colorado. 111 Pacific 610.

INDIAN LAND—

Where a riparian proprietor settled on his land while it was Indian country, but continued to reside thereon when the country was opened to settlement, and thereafter acquired title, such title would relate back to the date of the opening, and his riparian rights date from that event. *Redwater Land & Canal Co.* v. *Reed,* Supreme Court of South Dakota. 128 Northwestern 702.

DAMS—

A lower riparian owner must show some damage in order to restrain an upper owner from the beneficial use of the water, so that an upper riparian owner may dam the waters of a stream for the purpose of floating logs therein, if such use did not interfere with the water rights of the lower owner. *San Joaquin & Kings River Canal & Irrigation Co.* v. *Fresno Flume & Irrigation Co.* Supreme Court of California. 112 Pacific 182.

APPOINTMENT OF WATER COMMISSIONER—

The bounds of judicial authority are not transcended by the appointment of a court of a water commissioner charged with the duty of distributing the waters of a river among the various irrigation canals according to the adjudged priorities, and imposing upon the parties a *pro rata* liability for his salary. *Montezuma Canal Co.* v. *Smithville Canal Co.* Supreme Court of the United States. 31 Supt. Ct. Rep. 67.

JUDGMENT AGAINST USERS OF WATER RIGHTS—

Irrigation canal companies and persons claiming under them, made parties to a suit over water rights, whether viewed as appropriators of water, or as mere carriers for others, sufficiently represent the users of the waters of the respective canals to cause such water users to be bound by the judgment. *Montezuma Canal Co.* v. *Smithville Canal Co.* Supreme Court of the United States. 31 Supt. Ct. Rep. 67.

WATER RIGHTS—

A decree determining the rights of an irrigation canal company in the waters of a river, as against the owners of other irrigation canals taking water from the river at points above the head of its own canal, and against all persons claiming under them, is *res judicata* as to such canal owners and the water users under such canals in a subsequent controversy over the respective rights of the appropriators of the waters of such river. *Montezuma Canal Co.* v. *Smithville Canal Co.* Supreme Court of the United States. 31 Sup. Ct. Rep. 67.

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whence a pumping plant will lift it up to the higher land of the farm.

Surveyors under L. M. Markham will begin preliminary survey of the $4,000,000 Bent-Prowers irrigation project, starting southeast of Las Animas.

With the new experiments to be made in raising water by electric power from the river flowing through San Juan County, much will doubtless be accomplished in the way of irrigation as a preliminary step in advance of the gigantic canal project to be put in later on, which may, in time, supplant the present irrigation system.

According to L. M. Stimpson, Chief Engineer for the project, the Great North Sterling Irrigation system, by which 80,000 acres will be brought under cultivation at a cost of $2,000,000 is practically completed. Engineer Stimpson will now begin work on the Sedgwick project, Sedgwick County, to irrigate 19,000 acres at a cost of $700,000.

On December 22d in Salt Lake, the Unita Land and Water Company was incorporated with a capital of $200,000. The company was formed for the purpose of taking over the Carey Act land enterprise, developed by the Uinta Realty & Investment Company of Vernal to put water on and irrigate land. It is estimated that 10,000 acres will be brought under cultivation soon.

As the result of a canvas, taken in a general way over Weld County, it is estimated that over 30,000 acres more land will be brought under cultivation the coming season.

County Treasurer P. W. Allen recently turned over to Weld County the Denver-Greeley Valley irrigation district land because taxes amounting to approximately $60,000 were not paid. At a meeting held January 3 creditors of the Standley Lake and Associated Systems present and the matter of adjusting financial affairs were taken up. Subsequently what is due Weld County will be paid. Charles R. Brock, William R. Kenefick and Milton Smith are among those who are interested in the project

Plans for the formation of an irrigation district to be known as the Fort Collins-Loveland district were announced when the organization committee served notice it was petitioning the board of county commissioners to call a special election to vote on a bond issue

Reports from Green Mountain, where a construction crew under J. A. McIlwee, contractor for the Laramie Poudre Tunnel is cutting a three-mile bore through the Medicine Bow Range, are that unless something unforeseen happens, within a short time the crew will break the record for tunnel construction.

The Secretary of the Interior has authorized the Reclamation Service in connection with the Uncompahgre irrigation project, Colorado, to construct by force account the Cedar and Spring laterals, involving an estimated expenditure of $35,000 for both. It has been found impossible so far to let small contracts among local contractors for this work. If the work of constructing these laterals should be covered by contract it would leave the equipment and animals of the Service idle, thus involving an expenditure in the care of equipment and feeding and care of animals for which no return would be received. In view of these facts it is believed that the work can be performed more economically by force account than by any other method.

IDAHO.

It is stated that not less than one million dollars a month will be spent in Idaho during the year 1911 developing irrigation projects this includes the amount to be expended by the government and the most of it will be for labor.

Four thousand acres of fine land along the Snake River, near Medbury, are to be irrigated by waters secured from the One Thousand Springs Company.

Three thousand five hundred acres of choice fruit lands in the famous Spokane Valley have just been opened to settlement near Cour de 'Alene, in Kootenai County, Idaho.

F. J. Eitel, Vice-President of the Elmore Irrigation Company, who has been with surveyors in the upper Mountain Home country, returned to Mountain Home and report matters progressing in a satisfactory manner. Lines have been run across High Prairie and Moore's Flat to the south fork of Lime Creek and the work now on hand is a complete survey of the Camas and Long Tom reservoir. With adjacent systems of flumes, ditches and tunnels, this work is being done in as thorough a manner as if no system had ever been in existence in that section. All of the land being re-surveyed was under the old Mountain Home project, about which there has been so much disruption and trouble. Under the Garnet regime this section passed through varying difficulties and it is now hoped that under the new arrangement a well developed system may result.

The Spokane Valley Commercial Orchards Company has been incorporated for $200,000 by business men of Spokane to develop 2,000 acres of land west of Hayden Lake, Idaho, 30 miles from Spokane. It is estimated that $250,000 will be expended in improvements and this, added to the original purchase price of the land, $175,000, will bring the total expenditure up to nearly a half million dollars. It is stated that an underground and domestic water system will be installed.

The Army and Navy Board has appropriated $7,113,435 to the two irrigation projects in Idaho; $6,500,000 to complete the Payette-Boise and $528,000 to complete the Minnidoka, according to present approved plans. The expenditure of this vast sum of money means wonderful prosperity in Idaho for a number of years to come.

I. W. McConnell, Manager of the Idaho Irrigation Company, visited Hailey recently accompanied by M. S. Darrow, the well known engineer who has severed his connections with the company to go east to assume the superintendency of the Barber Asphalt Company in New Jersey. Mr. McConnell was the engineer for the Pathfinder Dam in Wyoming, that is said to wall in the largest reservoir in the world. He was also the engineer in charge of the Gunnison Tunnel in Colorado.

In accordance with the report of the board of consulting engineers of the Reclamation Service, the Secretary of the Interior has tentatively allotted the sum of $1,000,000 to expedite the work on a storage reservoir in the Boise River for the Boise irrigation project, Idaho.

Negotiations are authorized for the construction of a railroad or, in the event of failure of such arrangement, to build a suitable road to the dam site at Arrow Rock. Authority is granted also to erect the necessary power plant and transmission lines to excavate diversion tunnels, secure necessary rights of way and all other details preliminary to actual construction of the big dam in the Boise river. The structure will be one of the biggest dams in the world and its construction offers a very difficult problem in engineering.

The Secretary of the Interior has awarded contracts to the following for furniture lateral head-gates in connection with the Payette-Boise irrigation project. Schedules 1 and 2, Gilbert Hunt Co., Walla Walla. Wash., $2,824. Schedules 3, 4, 5, 6, and 7, Minneapolis Steel and Machinery Co., Minneapolis, Minn., $2,172.

NEW MEXICO.

The Secretary of the Interior has authorized the Reclamation Service to renew a contract with the Elephant Butte Water Users' Association for the delivery of water to the Association for the irrigation of certain lands in the Rio Grande Irrigation Project, New Mexico. The object of the contract is to provide for the delivery of water temporarily upon a rental basis to irrigated lands under the Leasburg section of the project pending under the terms of the Reclamation Act.

The water is to be conveyed through the Leasburg canal and delivered to the Dona Ana, Las Cruces, and Mesilla Community ditches during the season of 1911. The charge for water is fixed at 10 cents per acre-foot of water delivered to the ditches.

Six hundred applications for the right to appropriate water have been filed with the Territorial Engineer since January, 1907. Previous to that time certain laws regulating the use of water had been in the statute books of New Mexico, but they were only developed and brought into practical existence on the date mentioned. During the last two years 285 applications to appropriate water have been filed. The amount of water sought to be appropriated by these filings covers something over 2,000,000 acres.

Hugo Seaburg of Raton and associates has acquired from the Santa Fe Railway Company 98,000 acres in Curry County. These lands lie northeast of Melrose and the purchasers will develop them by boring for artesian water and installing pumping plants and irrigation system, colonizing, town-sites and establishing industries.

Work on the reservoir for the Ranchos Orchards and Land Company has been begun and will be pushed as rapidly as possible until Spring, when a large force of men will be engaged and the reservoir made ready for use at the earliest possible moment. This is one of the biggest improvements for the Taos Valley and brings under irrigation a large and splendid tract.

The prospectus of the Red River Land and Water Company has been issued, setting forth the intention of using 34,000 acres of land in northern Taos County. This section, which is a continuation of the San Luis Valley of Colorado, has never been opened up by a railroad or any other development project. The land to be irrigated by the enterprise is the first selection of lands under the act of Congress, June, 1898. The project has been approved by the territorial engineer and construction work has been commenced on the dam.

C. C. Magenheimer, representing German capitalists interested in the proposed merger of the irrigation land companies of southern Colfax County, C. T. Irwin and son, of Chicago, Sophus' Richards, General Manager of the French Land and Irrigation Company; President Cowan of the Maxwell Irrigated Lands Company, and Captain William French of Cimarron were in Springer for the purpose of looking over the Springer Ditch System lands. The proposed merger will mean the irrigation of 100,000 acres of land. It will take in the Springer Ditch System and lands, the French Land and Irrigation Company, the Maxwell Irrigated Lands Company, the Charles Springer lands between Springer and Cimarron and a number of small holdings.

A tract of 640 acres, four pumping plants each operated by a 25 H. P. Loomis Oil Engine, which lifts the water 33 feet, is planned near Roswell. New Mexico by a local rancher, who will demonstrate the feasibiliy of irrigation by pumping. He expects to show the people of the Pecos Valley that irrigation by pumping water is much more simple and economical than has been supposed.

MONTANA.

A contract has recently been let for enlarging and extending the Sanders Irrigation canal at an expense of nearly $100,000.

Montana lands, approximating 204,000 acres were recently designated by Secretary Ballinger of the Interior under the Enlarged Homestead Act as being not susceptible for successful irrigation. This land is located in the northwest section of the state.

About 70,000 acres of a large tract withdrawn under the Carey Act in connection with the Winnett Reclamation project in the Flat Willow Country has been restored and today is thrown open to entry. This is said to be a fine bunch of land and will be soon taken up by settlers.

On Aprl 1, 1911, at 9 a. m., the Secretary of the Interior will throw open to entry a number of new farms on the Sun River irrigation project. The area for which water will then be ready contains some of the choicest land in the project, including, as it does, a part of the lands formerly occupied by the Indian school. Some of these farms are just outside of the limits of the new town of Fort Shaw. The water right charge is only $20 per acre, payable one-tenth down at the time of filing and the balance in annual installments over a period of ten years, without interest.

WASHINGTON.

Western capitalists recently organized the Klickitat Valley Development company with a capitalization of $750,000 to reclaim and irrigate 20,000 acres in the Camas prairie country, fifteen miles northeast of Husum, Washington. Construction was begun above Glenwood on a headgate and flume of seven miles. At this point the canyon walls are steep and it is necessary to flume the water until the level of the adjacent country is reached. Here, where the flume is 700 feet above the canyon bed, an electric power plant will be installed, from which it is estimated 40,000 horsepower can be produced.

Secretary Ballinger is being flooded with telegrams from prominent citizens of Pasco and vicinity asking that funds be set apart from the reclamation fund for the construction of what is known as the Pasco irrigation project, which embraces 100,000 acres, lying east of the town of Pasco.

This project was examined by the Reclamation Service in 1905 and turned down because of the unfavorable report of the engineers, who found that on account of the porosity of the soil, it would be necessary to line all canals and a big storage reservoir in Washtucna Coulee with cement. This, they held, would so greatly increase the cost of the project that the land could not stand the charges.

Not having been approved by the Secretary of the Interior, this project, under the law, is not eligible to receive any allotment from the special $20,000,000 fund. The fact that the Government is committed absolutely to the Yakima project means, furthermore, that what money is available from the regular reclamation fund must be applied there, until that project is completed.

The Pasco project, it is pointed out, differs from West Umatilla in that the latter is the extension of an existing project and as such is eligible to receive an allotment. Moreover, unless the Government builds the West Umatilla project immediately, it will forfeit its water right in October.

Suggestion has been made to the Chamber of Commerce, Ballingham, Washington, looking to the securing of government assistance in clearing cut-over timber lands in the Puget Sound counties and putting them in shape for immediate cultivation. Those who are back of the movement claim that the Washington Delegation in Congress should be interested and that the plan is just as feasible and equally in line for progress with the federally patronized irrigation projects. It is held by those who favor the scheme that the Puget Sound district will be put forward twenty-five years in development if government assistance can be secured whereby any considerable quantity of lands are made ready for the plow.

Seven thousand acres of land are to be irrigated near the town of Yelm. A meeting was held recently at Olympia and money was raised to go forward with the preliminary work.

The Lower Yakima Irrigation Co. is negotiating with the Pacific Light & Power Co. for the construction of a transmission line to connect with the high-tension line of the Pacific Co., to furnish electricity for the pumping station of the Lower Yakima Irrigation Co.

The Whitestone Irrigation and Power Company of

Loomis, Washington, has been incorporated to irrigate 10,000 acres of fruit land in the Okanogan country.

Support of an irrigation system which will water 300,000 acres of the Horse Heaven country, a vast section of arid land in Yakima, Benton and Klickitat counties, was asked in a joint memorial presented to the Washington Legislature recently by citizens of King and Kittitas counties. The irrigation of the Horse Heaven country has been under way for the past seven years and when completed will be the largest system in the state of Washington. The main canal, 122 miles long, is to be built from the head waters of the Klickitat river. large reservoirs are to be constructed, 200 miles of laterals will be built, while 1,000 miles of distributing laterals will be necessary. The cost of this system is estimated at $13,000,000, which amount will be furnished by Minnesota capitalists. It is estimated that the lands will support a population of 150,000 and will add $100,000,000 to the valuation of the state.

This canal cannot be completed for another five years and the homesteaders who have filed under the desert lands act and who have been paying assessments on the land by subscribing to the irrigation company must have more time to prove up on their land or lose it under the federal law, which ordains that desert claims must be supplied with water within four years from the time of entry. In some cases extensions have been made.

Central and eastern Washington private capitalists will start work in the spring of 1911 in a great irrigation plant to water 1,000,000 acres, which it is estimated will cost, eventually, $55 000,000.

OREGON. S

Word was received at Klamath Falls, Oregon, not long ago from one of the farmers in that vicinity who has been visiting Washington, that the upper Klamath Falls project is again to be taken up by the reclamation service. This project was originally a portion of the Klamath Falls project proper.

Four thousand acres of land are to be irrigated by a Portland syndicate in the Willamette Valley for which water rights have been obtained. These lands lie near the towns of Turner, Marion and West Slaton.

There are millions of acres of valuable land in Oregon which can be reclaimed with a proper system of irrigation. Several private companies are doing what they can in the Deschutes country. The government is irrigating two sections by means of the Umatilla and Klamath projects. The former irrigates 20,000 acres, a part of which has already been opened for settlement. In the latter project 190,000 acres of land are being reclaimed, two-thirds of which lie in the state of Oregon.

A large irrigation project is to be undertaken in Harney Valley in the spring of 1911. Speaking of this project C. W. Parrish says, "The future of inland Oregon depends largely upon the success along irrigation lines." The land in Harney Valley lies adjacent to the town of Burns and this land, it is said, may be made to produce most anything that grows, with the application of water.

People of the Grant's Pass district, failing to get irrigation from corporations, have resolved to take the business in their own hands and have commenced to organize an irrigation district under the laws of Oregon.

Final report of Charles M. Redfield, Receiver and Special Commissioner of the Deschutes Irrigation and Power Company, was made to Judge Beam in the United States court of Oregon recently.

The report was accepted and Mr. Redfield discharged. During the time of the receivership, from April, 1910, to October, 1910, when the company was reorganized, Mr. Redfield received in cash $95,138, of which $44,000 was in cash from the company and the remainder from payments of settlers on the company's lands.

Sycamore, Illinois, people have recently closed a deal for 24,000 acres of Hay River Valley land in Oregon. It is stated that the purchase price was something like $400,000.

President Kern, of the Agricultural College, is assured by the authorities at Washington that the support of the Federal Government will be given to the extension of the agricultural experiment work in that state. The irrigation experiments will be carried on throughout the Willamette Valley.

The irrigation of 20,000 acres of land in the upper Umpqua and Cow Creek valleys in Douglas County, Oregon, is a project undertaken by a company of Chicago men represented by John C. White of Pittsburgh, who has made his headquarters at Rosebud for the past year. The company does not intend to buy any land or right of ways for the enterprise. They plan to build and maintain the irrigation system under the municipal district law. which gives land owners along the route of a proposed ditch the right to vote bonds for installation of such a system and district toll for the use of water. Mr. White estimates that the system will cost about $800,000.

George C. Clark, of Everett, has the contract for construction of the Lost River Diversion Works, in connection with the Klamath irrigation project. The work consists of a concrete diversion dam, culverts, bridges, etc., and involves about 5,500 cubic yards of concrete and 40,000 cubic yards of excavation and embankment. The contract price is $98,556.50.

W. H. Mason, of Klamath Falls, was the lowest bidder for the construction of the Lost River Diversion Channel, Klamath irrigation project. The contract involves the construction of approximately 332,400 cubic yards of earth and rock, to be performed within fifteen months from date of award, for the sum of $63,607.

UTAH.

Plans are materializing for two Carey Act irrigation projects that may mean the expenditure of two or three million dollars in the reclamation of about 40,000 acres of arid land. One project is in the Vernal district and the other one is known as the Spanish Land and Water Company and its application has been approved by the Stated Land Board. The tract is in Grand and San Juan counties and comprises 8,000 acres. The project would cost the company over $700,000. Moat is the nearest town.

The state of Utah has just completed the Piute Canal and Reservoir project and is now contracting to deliver water to the settlers on the lands covered by this one-quarter million dollar project.

"Less than 4 per cent of the land area in Utah is now under irrigation and not more than 6 per cent can ever be irrigated," is stated by the *Wasatch Wave* of Heber City. Of the 22,000 acres susceptible to farming, only one-tenth is now cultivated.

Plans have been submitted the State Land Board by the Blue Mountain Land and Irrigation Company, which proposes to irrigate 135,000 acres of government and state land in Rio Blanco and Routt counties, Colorado and Utah. Water is to be taken from the White river.

Five hundred feet of tunnel, Strawberry Valley irrigation project, were excavated during the month of November and 563 feet were lined with concrete. This tunnel when completed will be four miles long and will carry water from a storage reservoir in Strawberry Valley through the Wasatch Mountains and empty it into the Spanish Fork River, from whence a canal eighteen to twenty miles long will convey them to the irrigable area. The tunnel is now 38 per cent completed . About 60,000 acres of land on the east shore of Utah Lake will be watered by this system.

(Continued on Page 795.)

(Continued from Page 792.)

MISCELLANEOUS.

C. E. Boyd of Trinidad, Colo., who has made an exhaustive study of irrigation and subirrigation, while in Oklahoma City recently stated that he had traveled extensively throughout Western Oklahoma and had reached the conclusion that sub-irrigation is the key that will solve the problem of Oklahoma's greatest agricultural prosperity—sub-irrigation and small farms.

The Coloradoan referred to artificial sub-irrigation, which is accomplished by watering the subsoil by means of porous tiling. "By sinking deep wells and employing this sub-irrigation method," he said, "ten acres of Oklahoma soil should become more productive than the average 160-acre farm of Western Oklahoma at the present time and as now farmed. By this method Western Oklahoma and the Texas Panhandle should become a veritable garden spot."

The irrigation projects of the United States have called for the erection of the five largest dams in the world.

The Western Power and Irrigation Company, Mountain View, Oklahoma, announces the plan to develop water power with 12,000 H. P. available.

Texas may find a new way to raise cotton by irrigation. A company of northern capitalists have just closed a contract for 1,000 acres of land in the Mission section of the Rio Grande Valley to be devoted to the cultivation of cotton by irrigation and there is a large force of men at work preparing the ground for planting.

A company is being formed by Paw Paw, Michigan, people to put an irrigation project in operation at Paw Paw in the heart of the "original fruit belt." They have purchased land on the western bank of the Paw Paw River for the reservoir site, where sufficient water will be stored to irrigate all of the district lying north of Paw Paw.

An agreement just effected between the owners along Milk River, Montana, may result in the government proceeding with the construction of irrigation works in the Milk River Valley.

One million, seven hundred and fifty thousand in One Pound shares will be the capitalization of the Canadian Wheat Lands, Ltd., a new company formed for the purpose of acquiring about 65,000 acres of land northwest of Medicine Hat. The prospectus of the company is a glowing one and the statements in it representing the value and the character of the land are made on the authority of J. G. McGregor and J. W. Dennis. As to the character of the land, it is said that it is excellent for the growing of wheat either under the dry farming system or irrigation.

Senator J. H. Stewart, of Sedgwick County, Kansas, is preparing a law to conserve the artesian wells and artesian fields of the state. The bill which he is preparing is based on the present New Mexico law, but includes a number of changes which are deemed advisable for Kansas.

A committee of Chciago bankers has been formed to protect the interests and holdings of the Conrad Land and Water Company of Montana and the Big Lost River Irrigation Company of Idaho, which defaulted on the interest on January 1st. These issues were floated about one year ago by a Chicago bonding house which subsequently became financially embarrassed as a result.

The Secretary of the Interior has approved the contract entered into by Supervising Engineer H. N. Savage of the United States Reclamation Service on behalf of the United States, with Emanuel Thomas of Byron, Wyo., for the construction of distributary ditches under the Frannie Canal and Lateral A of the Shoshone irrigation project, Wyoming, at a contract price of $4,940.50. The work covered by schedules 3 to 6, inclusive, involving the construction of structures under Frannie Canal and Lateral A, will be done by force account.

(Continued on page 800.)

St. Mary-of-the-Woods

ST. MARYS, VIGO COUNTY, INDIANA

For Young Women and Girls

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COLLEGE—Four Years Course. Academy—College Preparatory and Finishing Courses. Intermediate department. Conservatory of Music, with vocal, piano, harp, violin, pipe organ, etc. Oil and Ceramic studios. Modern languages by native teachers. Foreign Travel Course.

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SISTER DIRECTRESS, DEPT. A

St. Mary-of-the-Woods, St. Marys, Vigo County, Indiana.

(Continued from Page 780.)

to quickly wet the land even to the extent of ponding the surface, they employ what is known as stop-boxes or pockets, near the lower end of the tile at the drain ditch and by plugging the tile in the stop-boxes, very quickly get the land wet enough for any purpose, such for instance, as transplanting any of their crops. Mr. Whitner says further that the land should be nearly level. If it is not, the rows of 3-inch tile, 25 feet apart, should be put in parallel with the slope so that the lower end should be only a few inches to the 100 yards lower than where the water is turned in; the water supply being at the highest point and by gravity running through the entire system, and discharging into the drainage ditch at the lowest point.

It is stated that the supply of water can be regulated so as to irrigate the entire field simultaneously, or, if desired, may be confined to a single row of tile, hence a variety of crops requiring varying quantities of water may be handled with perfect safety. To further illustrate the ease with which the water supply is controlled, Mr. Whitner says that one may have a crop growing where it is desirable to keep the ground comparatively dry, while on the adjoining plot it may be necessary to saturate the plot to set plants. This can be readily done without expense, the only effort necessary being to insert a stopper into the boxes leading into the tile drain in the former and to withdraw it in the latter.

This system of tile laying produces also a perfect system of drainage, hence the two dangers to farming—too much water or too little—are under entire control.

In addition to the foregoing advantages the tile drains carry warmth and air, or rather warm air to the roots of growing crops and wonderfully stimulate and quicken their growth.

In conclusion it may not be out of place to reiterate the statement that a careful study of this subject will prove profitable to all manufacturers of drain tile.

(Continued from Page 782.)

6. Similarity.

Triangles are similar when the angles in the one triangle are respectively equal to the angles in the other triangle.

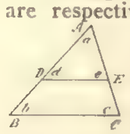


Fig. 29.

In Fig. 29 the line DE is drawn parallel to BC, then angle d = angle b, and angle e = angle c, and the angle a is as well in the triangle ADE as in triangle ABC; so the triangle ADE is similar to triangle ABC, and the sides in the one triangle are proportional to the sides in the other which gives the proportions:

$AD : AB = AE : AC$; also,
$AD : DE = AB : BC$; also,
$AE : DE = AC : BC$, etc.

In picking out the proportional pieces care must be taken that it is done correctly, *i. e.*, that the pieces are similarly placed, so if AD is picked as the first antecedent and DE as the first consequent, then the second antecedent must be similar located in the other triangle; AD lies opposite the angle e and angle e = angle c, so the line opposite angle c corresponds to AD; this is AB; likewise, the first consequent DE lies opposite angle a; hence, the second consequent must have the same position in the other triangle which points to line BC lying opposite the same angle.

7. Mean Proportionality.

When in a proportion the two middle terms are equal it is called a mean proportion, for instance:

$a : b = b : c$,

which by forming the products of means and extremes gives the equation.

$b^2 = ac$.

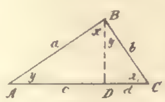


Fig. 30.

This principle is demonstrated in a right angle d triangle ABC, Fig. 30, in which the line BD is drawn perpendicular from the right angled corner to the Hypothenuse; then there are three similar triangles; triangles ABC and ABD are similar; hence the sides are proportional; let $AB = a$, $BC = b$, and $AD = c$, $DC = d$, and $BD = h'$, then $: c + d : = a' = a : c$; also $c + d : b = b : d$. This means that the perpendicular from the right angle of a right angle triangle to the Hypothenuse divides it so that each of the other two sides is a mean proportional between the adjacent segment of the Hypothenuse and the Hypothenuse.

Also, triangle ABD is similar to triangle BCD, then $a : b = c : d$, and this shows that the perpendicular drawn from the right angle to the Hypothenuse divides the Hypothenuse proportional to the two adjacent sides.

The first principle proves also the forty-seventh problem of Euclid, that the square of the Hypothenuse is equal to the sum of the squares of the other two sides as follows:

Form the product of the means and extremes:

$a^2 = c\ (c + d)$.
$b^2 = d\ (c + d)$.

Add these two equations together:

$a^2 + b^2 = (c + d)\ (c + d) = (c + d^2)$;

but $c + d$ is the Hypothenuse.

As an example let AB = 4 ft., BC = 3 ft., and AC = 5 ft., then c and d can be found from the proportion:

$4 : c = 3 : 5 - c$, or

form the product of the means and extremes:

$3c = 4\ (5 - c)$.
$3c = 20 - 4c$. Add $4c$ on both sides:
$7c = 20$. Divide both sides by 7:
c = 2.857 ft.

then $d = 5 - 2.857 = 2.143$ ft.

To find the height $BD = h$ use the proportion:

$h : 4 = 2.143 : 3$.
$3h = 8.572$.
h = 2.857 ft.

To change the decimal fraction of the feet into inches, multiply by 12; thus: $12 \times .857 = 10.28$ inches. To change the decimal fraction of inches into the nearest 32nd of an inch, proceed as follows: Subtract 1 from the nearest 1/100, if fraction lies between 12/100 and 37/100; subtract 2 if fraction lies between 38/100 and 63/100; subtract 3 if fraction lies between 63/100 and 87/100, and subtract 4 when the fraction lies between 88/100 and 100/100; then divide by 3 and the nearest number in the quotient will be the answer in 32nds; thus, to change the 28/100 inches above into the near-

(Continued on Page 801.)

This Grader Solves Your Irrigation Problem

Saves Time, Saves Horses, Saves Labor, Saves Money and Absolutely Gets the Water on Your Land

The Original One Man Machine

The 20th Century Grader enables you to get the wealth from land with the least labor and expense. This wonderful machine—weight only 600 pounds—with **one man** and **two or four horses** does the same work in **half the time** needed by big, heavy graders with two men and four or six horses.

The 20th Century makes irrigation farming surprisingly **easy.** You can put it to a score of uses, saving labor, time and money. It is the most serviceable, handy and practical machine you can have on your place—saves you the cost of several expensive machines that you need, although you use them only once a year. This grader gets the water on your land **without fail.** Farmers have **proved** it.

The 20th Century is built of steel and built right—light draft—every part stands its proportionate strain—the pull of the team concentrates at the point of the blade. **Every ounce of power goes against the dirt.**

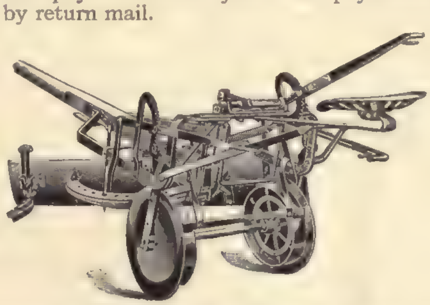
And it **works right,** too. One man handles it easily. It turns in a 10 foot circle. Blade can be set any angle and easily **reversed.** The

20th Century Grader

will solve your irrigation problems—cut your work in half—make bigger profits. With this remarkable money-maker your year's work will bring you a bigger return with less effort and less expenditure for machinery and horses.

Here is an opportunity to learn about the farmers' most useful and modern machine. You ought to know all about it. Send today for our free catalogue containing complete descriptions and fine illustrations from actual photographs of these wonderful little steel graders at work. Read what farmers who use them have to say.

Mail the coupon or a post card **now.** Information which which will help you to make your land pay better will be sent you by return mail.



Grader has only Two Wheels, both behind Blade. Flanged Wheels prevent side drift.

What This Grader Does For You

- Cuts Laterals for Irrigation.
- Makes Shallow Drainage Ditches.
- Cuts Side Ditches.
- Levels Fields for Irrigation.
- Throws Up Dikes for Rice Farming.
- Slashes Off Sage Brush.
- Grades and Crowns Roads.
- Cleans Laterals and Throws Borders.
- Maintains Gravel and Dirt Roads.
- Moves Dirt Anywhere and Drops It Where You Want It.

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Please send your free illustrated catalog of the 20th Century Grader.

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(Continued from Page 795.)

A million-dollar irrigation dam is to be built near Fallen, Nevada. A million of acres are to be reclaimed in the state of Nevada under the Carey Act by utilizing artesian wells.

E. H. Perry is putting down a well on his farm, four miles outside of Plainview, Texas, on which he will make a thorough test of the Wiggins system of sub-irrigation. He is digging ditches preparatory to installing the tiling.

Commission has been granted to a big company, headed by A. Allen of Denver by the County Commissioners of Elko County, Nevada, to construct a large irrigation project to be known as the Fort Halleck Irrigation district. A reservoir will be constructed which will supply in all about 13,000 acres of land.

As a result of the purchase of 712,000 acres of land in the upper peninsula of Michigan by H. H. Hamilton of St. Paul for the Western Securities Company of that city from W. H. Mather, employment will be given to 5,000 men in that district this year. It is the intention of the company to spend $5,000,000 on drainage and other improvements.

One and a half million pounds sterling has been set aside by the New South Wales Parliament for irrigation. Included under this head is the construction of the Barren Jack Dam and 1,000 miles of canals. Experienced irrigationists are wanted in connection with this scheme.

The Federal Government of Mexico has taken another step toward utilizing the water of the rivers and smaller streams of the country for reclaiming arid lands by irrigation. About two years ago a law was enacted for the payment of liberal subsidies for all land reclaimed by irrigation, an appropriation of $20,000,000 being made for the new service.

J. W. Dickson and H. Carr, the latter of Lee County, Texas, have just returned from Plainview where they carefully examined the great well which furnishes more than 2,000,000 gallons of fine water daily. These gentlemen think that the problem of irrigation is solved in that section and that tremendous development will follow.

A recent dispatch from Brownsville, Texas, says: "It was learned today that Amos W. Gardiner, of Houston, is negotiating for the purchase of a controlling interest in

(Continued on Page 801.)

ARTICLES OF CORPORATIONS

The following corporations have been organized in the various western states:

The Missouri-Texas Land & Irrigation Company, of Houston, Texas. Capitalization, $1,000,000. Incorporators are H. P. Hilliard, of St. Louis; Henry L. Borden, of Houston, and R. L. Betts, of Austin.

The San Benito Irrigated Land Company, of San Benito, Texas. Capitalization, $15,000. Incorporators are Alba Heywood, O. W. Heywood, S. A. Robertson, and R. L. Betts.

Robert H. Atkinson Land Co., of St. Joseph, Mo. Capitalization, $100,000. Directors are Hon. William K. Amick, Circuit Judge; E. L. McDonald, E. M. Atkinson, and Robert H. Atkinson, all of St. Joe, Mo., and E. W. Waite, of Topeka, Kansas.

Pueblo Development & Securities Company. Directors are W. F. Cox, J. W. Lester, and S. R. Ketcham.

La Noris Irrigation & Development Company of Raymondville, Texas. Capital stock, $18,000. Incorporators are William S. Overstreet, S. L. Gill, C. H Pease and others.

Columbia-Clarke Land & Irrigation Company, of Spokane, Washington. Capital stock, $22,000. Incorporators are Barnett D. Dixon, Otto Hubenthal, William Feldman, and others.

Spanish Fork Southeast Irrigation Company. Capital stock, $15,000. Directors and officers are Warren E. Davis, president; Sylvester Bradford, vice-president; Brigham E. Gardner, secretary and treasurer.

Aztec Irrigation Company of Colorado. Capital stock, $500,000. Incorporators are Arthur Ponsford and Dr. Roosevelt, of Denver, and W. Goff Black, of Aztec, N. M.

(Continued from page 800.)

the Brownsville Irrigation Company, the oldest and one of the largest canal companies in the Rio Grande Valley. He is acting for Cleveland, Ohio, capitalists and already has purchased 40 per cent of the stock and expects to take over more. The company is capitalized at $100,000 and owns a pumping plant six miles west of here capable of irrigating 20,000 acres. The corporation also owns thirty-five miles of canals and 3,500 acres of land.

A sub-irrigation scheme which has been tried extensively in the vicinity of Garden City, Kansas, is to be tried near Liberal, Kansas. The plan is to make tile on the farms and lay them in such a way as to irrigate the sub-soil. It is claimed that land irrigated by this system will produce from 200 to 300 per cent more than the same land not irrigated.

APPROVES NEW POWER PERMITS.

A new form of water power permit and new regulations for water power plants on the national forests were approved recently by the Secretary of Agriculture. Embodied in the new regulations are provisions for the issuance of a preliminary permit which secures to the party making the first application protection during the time necessary to make his final surveys and procure the data for the issuance of the final permit. The new permits terminate at the expiration of fifty years, unless revoked sooner by the Secretary of Agriculture, and the charge will be based upon the net horsepower capacity of the plant,, beginning with a charge of 10 cents per horsepower during the first year and rising gradually 10 cents per year to $1.00 per horsepower in the tenth year, which charge will continue thereafter. Computed for the fifty-year period, the charge under the new permit is about 30 per cent less than that under the old form. Provision is made for a readjustment every ten years of the factors upon which the estimated capacity of the plant is computed. It is believed that the new regulations will encourage extensive water power development in the national forests under provisions which will fully protect the interests of the people.

(Continued from page 798.)

est 32nd, subtract 1, which makes 27; divide by 3, which gives 9; so the answer is 9/32 inches. To change, for instance, .57 inches to the nearest 32nd, subtract 2 from 57, making 55, divide by 3 gives 18; so the nearest 32nd for .57 inches is 18/32 or 9/16. To change .81 inches to the nearest 32nd subtract 3 from 81 = 78, divide by 3 = 26, so 26/32 = 13/16 is the answer. Also, to change .95 inches to the nearest 32nd, subtract 4 = 91, divide by 3 = 30; hence, 30/32 = 15/16 is the answer. For fractions smaller than 12/100 no subtraction is made; for instance, to change 8/100, divide 8 by 3 =3; hence 3/32 inches is the answer.

Owing to the rapid development of the country embraced in the Belle Fourche irrigation project, South Dakota, the Secretary of the Interior has decided that an additional section of the North Canal must be constructed in 1911. The work proposed involves the excavation of approximately 770,000 cubic yards of material, mostly earth, at an estimated cost of $160,000. The extension of the canal is to be twenty-two miles. Bids will be received at the offices of the United States Reclamatoin Service at Belle Fourche, South Dakota, until 3 o'clock p. m., February 24, 1911, and full particulars may be obtained by addressing the officers of the service at Belle Fourche, South Dakota; Denver, Colo., or Washington, D. C.

The Chicago & Alton Railroad has just completed double tracking their line from Chicago to St. Louis. They also have installed a complete block signal system.

William K. Winterhalter has announced the opening of a Consulting Agricultural office in the Wright and Callendar Building, Los Angeles, Cal.

Attention will be given to agricultural investigations, development of lands, soil improvements, irrigation and drainage problems, farm management and agricultural recounting.

Grand Forks, N. D., Dec. 21, 1910.

Irrigation Age, Subscription Manager, Chicago.

Dear Sir: Enclosed find $1.00 as per enclosed printed matter for your magazine when my subscription runs out. I consider this one of the best dollars I ever spent.

(Signed) Harry K. Geist.

Cut Your Tire Bills in Two

These two Goodyear features jumped our tire sales last year to $8,500,000. They trebled our sales in one year. This year they will save millions of dollars to owners of motor cars.

Tires 10% Oversize

Goodyear tires are made 10% larger than the rated size. That means 10% more tire at no extra cost. It means 10% more carrying capacity. That extra size, with the average car, adds 25% to the tire mileage.

The reason is this:

Motor car makers, in these days of close prices, can hardly afford to give generous tires. The tire size is sufficient for the car as they sell it, but not for the extras you add. A top, glass front, gas tank, gas lamps, an extra tire, etc., add a great deal to the weight of a car. So does an extra passenger. So do extra heavy people.

Nine times in ten the expected weight is exceeded. A few hundred pounds of extra weight cuts down the tire mileage half. That is what causes blow-outs when tires are nearly new.

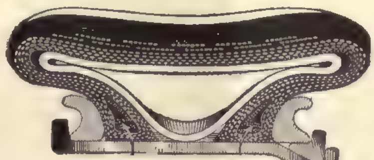
So we add 10% to the size of the tire without any extra cost. That takes care of much added weight. That extra size will save the average motorist at least 25% of his tire cost.

Rim-Cutting Impossible

Goodyear No-Rim-Cut tires get rid of this trouble entirely.

To run an ordinary tire flat—even a few hundred feet—may wreck it beyond repair. But No-Rim-Cut tires have been run deflated, in a hundred tests, as far as 20 miles. Among the half million No-Rim-Cut tires we have sold there has never been one instance of rim-cutting.

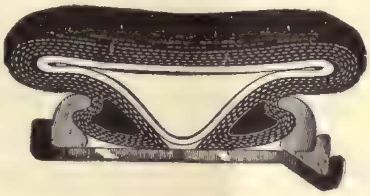
Note how to avoid it.



The 63 Braided Wires

Here is a Goodyear No-Rim-Cut tire fitted in a standard rim. This is the rim now used almost universally for quick-detachable tires. But Goodyear tires fit other rims just as well.

Note that the rim flanges—which are removable—are placed to hook outward with No-Rim-Cut tires. The tire comes against the rounded edge, making rim-cutting impossible under any conditions.



Here is an ordinary tire—a clincher tire—fitted in a similar rim. The rim flanges here must be placed to hook inward—to grasp hold of the hook in the tire base. That is what holds the tire on.

When the tire is deflated, as in the picture, it comes against the sharp edge of the flange. That is what causes rim-cutting. A punctured tire is often wrecked in a moment.

Hookless Tires

Goodyear No-Rim-Cut tires have no hooks on the base. They don't need to be hooked to the rim. The reason lies in 126 braided wires vulcanized into the tire base. That makes the base unstretchable. Nothing can force the tire off the rim until you remove the flange. It is so secure that tire bolts are not needed.

When the tire is inflated these braided wires contract. The tire is then held to the rim by a pressure of 134 pounds to the inch. That is why hooks are unnecessary. That is why you can turn the rim flange so it can't cut the tire.

We control these braided wires, and there is no other practical way to accomplish the purpose. There is no other way to make a hookless tire safe.

Last year Goodyear No-Rim-Cut tires cost 20% more than other standsrd tires. Yet our tire sales trebled. This year, because of multiplied production, they cost no extra price.

You can get these oversize tires, these No-Rim-Cut tires, by simply insisting on them. And that means a saving of half on one's tire bills under the usual conditions.

Our new Tire Book tells a myriad facts which motor car owners should know. It is full of money saving facts. Send us your address—now before you forget it—and let us mail it to to you.

GOODYEAR

No Rim-Cut Tires

THE GOODYEAR TIRE & RUBBER COMPANY, Eighty-third Street, Akron, Ohio

Branches and Agencies in All the Principal Cities. We Make All Sorts of Rubber Tires

(192)

Myers Power Pumps

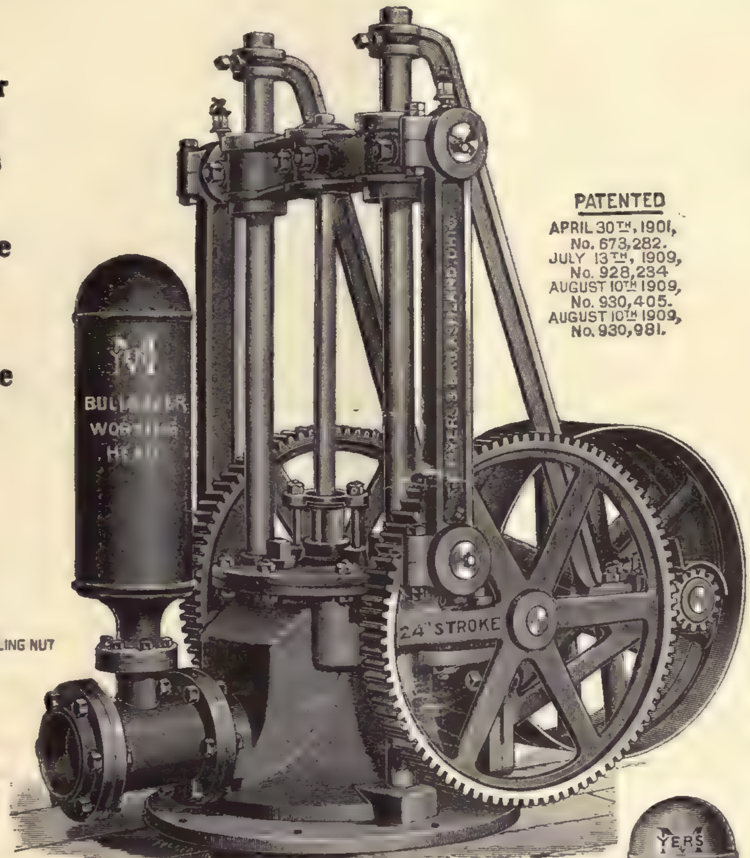
Working Heads, Pumping Jacks, Cylinders, Etc.

PATENTED

The Myers Bulldozer Power Working Heads For Deep Wells

Length of Stroke 5 to 24 inches

Size of Discharge Up to 6 inches



PATENTED

The Myers Bulldozer Power Pumps For Shallow Wells

Double Acting Length of Stroke 5 to 20 inches

Size of Cylinders 2½ to 6 inches

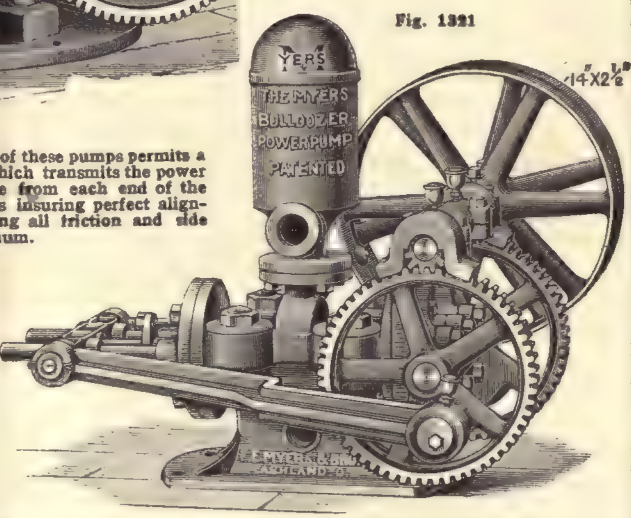
Size of Discharge Up to 4 inches

Capacities 600 to 7200 Gallons per Hour

Fig. 1321

Th construction of these pumps permits a double gearing which transmits the power in two lines—one from each end of the same shaft, thus insuring perfect alignment and reducing all friction and side strain to a minimum.

Write for Catalogue and Prices



F. E. MYERS & BRO., ASHLAND, OHIO

ASHLAND PUMP AND HAY TOOL WORKS

Twenty-sixth Year

THE IRRIGATION AGE

VOL. XXVI CHICAGO, MARCH, 1911. No. 5

THE IRRIGATION AGE

With which is Merged

MODERN IRRIGATION — THE DRAINAGE JOURNAL
THE IRRIGATION ERA — MID-WEST
ARID AMERICA — THE FARM HERALD

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D. H. ANDERSON, Editor

ANNOUNCEMENT.

"The Primer of Irrigation" is now ready for delivery. Price, $2.00. If ordered in connection with subscription, the price is $1.50.

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Interesting to Advertisers.

It may interest advertisers to know that The Irrigation Age is the only publication in the world having an actual paid in advance circulation among individual irrigators and large irrigation corporations. It is read regularly by all interested in this subject and has readers in all parts of the world. The Irrigation Age is 26 years old and is the pioneer publication of its class in the world.

National Extravagance and Waste a Menace.

It is claimed to be a serious fault of the American people that the idle rich waste their money in Europe. It is apparent that the amount of American capital spent abroad every year exceeds the average balance of trade between this continent and Europe. America does very well when our exports are three hundred millions over the imports. Such a balance in our favor gives us new capital and is sufficient to put new vitality into many industries. But what is gained to the nation if the balance of trade is in our favor to the extent of a third or a half billion and the moneyed classes turn round and spend as much or more in a season of extravagant living in foreign countries?

It is not the cost of travel at which financiers complain but rather the expenditure of vast sums for merchandise in Paris and London which ought to be circulated in the United States—in the country where the money is gained. In addition to this foolish buying there is much waste of American wealth in ultra-extravagant not to say riotous living. When we come to estimate this waste together with the large sum which annually is sent abroad by foreign-born laborers in this country who intend ultimately to return to their native land and live, it becomes apparent that the United States is suffering under different kinds of unfairness and injustice.

A nation can waste its sprplus just as an individual can and must suffer in something the same way. A sure method to produce hard times is to let the balance of trade turn against us and logically a sure way to produce good times is to keep drawing more money from the old world than our people spend abroad.

Nineteenth National Irrigation Congress.

Mr. Edmund T. Perkins, Managing Director of the National Irrigation Congress, which will be held here in December of this year, has been active in stirring up an interest in the movement and several luncheons and meetings of the Board of Control have been held; that held at the University Club February 24th, being the most largely attended of any since the movement began.

Mr. Perkins, who was formerly engineer in charge of the transportation and purchasing office of the United States Reclamation Service in Chicago, gathered during his ten years in office much information valuable to the merchants and manufacturers of Chicago as to the possible results from extended irrigation development of the west.

He attempted, at the luncheon, to show how, practically 10 per cent of all the money invested in western development eventually finds it way back to Chicago.

The members in attendance were much interested in the subject and a general movement will now be made to raise funds for the entertainment of the delegates to this Congress.

The IRRIGATION AGE will publish in a later issue a complete list of all of the officers of the Congress, as well as the local Board of Control.

Mr. Perkins explained to those in attendance the duties of the Board of Control and the importance of membership in the Board.

It is presumed that active work will be started at once to raise funds for carrying on the work of the Congress.

Irrigation Meets Demand for Improved Agriculture.

The demand for better farming in America is natural. From every part of the country comes the cry for improved agriculture. How to increase your exports, how to keep young men and women in the country and how to give greater profits to the farmer are questions which leading citizens everywhere are trying to solve.

It is only within the past few years that we have given much heed to the future. We have taken it for granted that our resources were unlimited and inexhaustible. We have opened wide our doors to the people of the Old World, and have invited them to take of our plenty. We have been rudely awakened to the fact that the day of free homes is about gone. The millions of acres of public domain stretching from the Mississippi Valley to the Pacific Coast are gone, except the treeless plains, the sage-brush deserts and the rugged mountains.

Land values in the humid states have increased so enormously that the man of small means finds it yearly more and more difficult to secure a foothold. The question of finding homes for our people is not one of the future—it is a paramount question to-day.

The true solution and in fact the only solution of this important problem, which has become both political and social in its aspects, is contained in the theory of small farms and intensive agriculture by means of irrigation. By turning the large places into little tracts, homes are made for many more tillers of the soil. By increasing production through better farming we meet the demand for larger exports. By placing agriculture on a more attractive and profitable basis we arouse the interest of young people and hold them in the country. Surely such results are worthy the best efforts of the farming class and the encouragement of all other classes.

A System of Underflow Irrigation Without Pumps.

A man of the name of James H. Donahoo has been telling the people that the great valley of the Arkansas may be irrigated by water from the underflow of the river by means of artesian water without the use of pumps.

Mr. Donahoo is a former resident of Sidney, Neb., and is said to be the originator and pantentee of a system of underflow irrigation which will revolutionize things.

His idea is apparently a simple one, although we have never learned of it being put to practical use. He states the well known fact that under the sands of the Arkansas Valley is a great flow of water. First a strata of seepage water is found, then below that is found the real underflow which extends down to the hard-pan. This underflow seeks its own level not far from the surface and, as all well drillers know, if a well is sunk a few feet in the sand, the water penetrates the perforated casing and will rise to the level of the surface of the underflow.

Mr. Donahoo's plan is to put down a row of pipes, about 40 feet deep and only a few inches apart. These pipes are to be cut off and connect with lateral tilings. The underflow entering the pipes through perforations will seek its level and run up into the tile which will carry it into a ditch without pumping being necessary. "I can lift every foot of water in the underflow to the surface by artesian force of its own," declared Mr. Donahoo. "And the only cost is the first cost of installation. I am now putting down two test holes near Garden City for demonstrating purposes and the water will be furnished to an irrigation canal south of that city within a short time."

If Mr. Donahoo is correct in his conclusion, and we have no reason to doubt him, he will revolutionize the work of irrigation through the underflow and we await the result with interest. It is doubtful, however, if any system such as suggested by him will change or materially affect the present method of lifting by pumps so that manufacturers of that class of goods may have no fear of immediate competition by natural forces.

List of Reclamation Officers and Organizations

For the benefit of our readers who are desirous of obtaining information concerning the various reclamation projects throughout the West, it has been decided to publish regularly hereafter in these columns a list of the officials of Reclamation Organizations, including the general officers at Washington, those of the southern division, which takes in Arizona, New Mexico, Texas, Utah and California; the Pacific division, which embraces Colorado, Oregon and Nevada; the northern division, embracing Montana, North Dakota and Wyoming; the central division, which includes Colorado, Kansas, Oklahoma, South Dakota and Nebraska; also the Idaho and Washington divisions.

The publication of this list will enable readers throughout the country to locate the individual with whom they should communicate in seeking information concerning any specific project. It may be well to state to those who are desirous of obtaining general information that it will be better to communicate with the statistician of the general office in Washington, D. C., whose name is given in the list, or direct inquiries to Arthur P. Davis, chief engineer, Washington, D. C.

The Age is in receipt of numerous inquiries from various sections of the country concerning the information given in this list and we trust that our readers may find its regular publication of value. This list will appear in our April issue.

Caution Necessary In Selecting A Property.

Many articles have been written relative to selecting a location in the west, and concerning this subject nothing more forcefully put than the suggestion by Mr. G. M. Allen, Deputy Commissioner of the Bureau of Statistics and Immigration of the State of Washington, who says: "It is not safe under any circumstances, to buy land without first having seen it, or, in any event, without having a report from some person of good judgment and established reliability. Inferior tracts may be found in the best districts, and the only way to make sure of avoiding such locations is to secure first-hand information before purchasing.

The Age agrees with the above statement, in fact is familiar with many cases where lands were purchased from agents in the East when after a few years the purchaser would make a personal investigation and find that base misrepresentation was practised. Mr. Allen further states: "There are a number of companies developing fruit lands in the state that undertake to plant the tracts they sell and care for same until the bearing period is reached. Where the responsibility of the company is fully established and the land is known to be adapted to the purpose, this plan of securing land may be profitably followed, the chief advantage lies in the fact that the purchaser may continue at his customary vocation during the period his land is nonproductive.

Recognition of Our Work. The Primer of Irrigation.

As an illustration of the way in which our "Primer of Irrigation" is recognized by readers, we quote part of a letter received from Mr. Newton Hibbs, secretary of the Lemhi Irrigation and Orchard Company, Ltd., Salmon, Idaho. Mr. Hibbs states, "The Primer of Irrigation, a copy of which I secured at the Chicago Land Show, has been very highly appreciated. I have been a practical irrigator for a great many years and know the use of water pretty well, but I had never stopped to consider why the good results followed the correct application of artificial water. The science of farming never presented itself with due force until I read your book."

We are very glad indeed to receive such kindly expressions from our readers and trust that those who have not secured a copy of our "Primer of Irrigation" may renew their subscription to the AGE and receive a copy post free without cost beyond the subscription price of the AGE. That is to say, by sending in $1.00 for one year's subscription, or by paying up your back subscription and signifying a desire to have the paper continued we will be glad to place your name on our books as a subscriber and forward the Primer immediately.

The fact of the matter is there can be no true science in soil cultivation unless the farmer has control of the degree of moisture that is to be applied to his various crops from the time the seed is planted. The uncertainty of natural precipitation makes all harvests uncertain, if not uneven. With perpetual sunshine and the correct application of water, scientific farming is at least possible.

The author of the "Primer of Irrigation" attempts to furnish such information as will lead to this result.

The book is paper-bound, and contains 260 pages with numerous illustrations. If you are in arrears for subscription, kindly remit the amount due, which is shown on the wrapper of this copy of the AGE and instruct us to continue your subscription, stating for how long a period you wish it carried, and a copy of the Primer will be forwarded immediately without cost to you. Please give this matter your attention today.

Are Officials Evading Law?

Word has reached this journal from time to time concerning the matter of employees of the Reclamation Service taking advantage of the knowledge obtained by them in their work and subsequently making entry upon lands under the various projects.

A prominent publisher of South Dakota stated recently that there are several instances where this was done in connection with the Belle Fourche, South Dakota project, and he also said that there is much dissatisfaction among the settlers, as it was the opinion of many that the localities on which such entries were made have been favored in the way of delivery of water or possibly better construction.

If this is true, it would be well for the Reclamation service officials, or the Department of the Interior, to make an investigation.

If the IRRIGATION AGE properly understands the reclamation law, it distinctly prohibits an employee of the Reclamation Service from making entry upon any land reclaimed under its provisions. It would be well possibly for the Department of the Interior to make a general investigation of the various projects and learn if this is a common custom. One may not blame a Reclamation Service official for a desire to obtain some choice piece of land, but the law was so framed that each of its officers were prohibited from making entry on account of their knowledge of soil and the other conditions, which would surround development of a tract so far in advance of its actual settlement.

A man in charge of a tract, or his sub-engineers, could, if he chose, pick off all of the choice locations and this would be eminently unfair if carried so far as the selection of or entry upon lands adjoining town-sites, the location of which is not known to settlers until the majority of entries are made on the tract.

Some years ago the writer traveled over the Belle Fourche tract with the then Chief Engineer, Mr. Walter, and discussed this subject with him. It was then stated that no definite knowledge concerning the location of the government town-site had been given out, although entry had been made upon lands in all directions from where it was finally located.

An investigation of these numerous complaints would do no harm, and possibly Belle Fourche would be a good place to start.

Problem of Blowing Soils Important To Farmers.

Farmer's Bulletin No. 421, issued by the United States Department of Agriculture December, 1910, covers the subject of control of blowing soils and this problem is important where there are considerable areas of bare soil exposed to the continued action of relatively high winds without accompanying rain-fall.

In the introduction to this bulletin it is stated that in the sandy sections even frequent rains do not suffice to hold the soil in sufficient check to entirely prevent blowing. The most important problem is the prevention of soil blowing on bare fields, or on fields so recently seeded that the crops have not made sufficient growth to protect the surface.

It is stated further that other problems, such as the prevention of soil blowing in cuts, embankments, etc., are sometimes important, but are much less so than the more widely extended blowing which occurs on ordinary cultivated fields.

In this publication the subjects of Normal Movements of the Soil, Causes of Excessive Blowing of the Soil and Means of Preventing this Damage are all taken up and treated in a comprehensive and instructive manner.

The subjects of suitable methods of cultivation, keeping the soil moist and the addition of humus, as well as artificial protectors are all treated extensively.

This is a bulletin well worth perusal by all farmers and may be obtained by addressing the United States Department of Agriculture, Washington, D. C. A request should specify Farmers' Bulletin No. 421.

Give Publicity To Senatorial Report.

It is difficult to tell at this time what will become of the report of the Senatorial Committee, who visited all of the reclamation projects under the chairmanship of Senator Carter, who is now retired.

There was, no doubt, a full report made, but a wrangle in the Committee and continued antagonism to the report being made public by a few members who were in favor of withholding it on account of their friendship for the principal officers of the Reclamation Servive, resulted in withholding this report, although it is stated by certain Washington correspondents that what purported to be the text of the report of the Senatorial Committee was not authorized by the Committee, which never passed on it and has so far refused to indorse it.

Senator Carter, who is, undoubtedly, better posted on

western conditions than the majority of senators now holding office, prepared the report with the assistance of some of his colleagues and attempted to have the Committee listen to the reading of it.

It is stated by those who opposed the report that one copy only was prepared and no advance copies were given to those who opposed it for consideration before the final vote was taken. As a result, no definite action is reported.

It is stated that Senator Chamberlain, who was one who opposed the report which was prepared by a majority of the Committee, demanded that it be printed and handed to each member for careful perusal.

It is noted also by western papers that Senator Chamberlain is upheld in his stand, which would be concurred in, no doubt, by all fair minded readers.

There is another phase to the situation, however, which is not generally understood by the reading public, viz., that Senator Chamberlain who has been carefully handled by the coterie of reclamation and forestry officials at Washington, has as a result been extremely friendly to them and has favored them in every way. This was distinctly noticeable at the time of the Sacramento Congress, of which Senator Chamberlain was president, he being at that time governor of Oregon.

The writer was secretary of this Congress and naturally in close contact with conditions and political manipulations of the meeting. It is a well known fact that Chamberlain was dominated absolutely by the government officials and assisted in his work by that oily politician, ex-Governor Pardee, of California, who had been president of a previous Congress.

There is no doubt in the world that Chamberlain was made president of the Congress at the time of the Boise Congress through the manipulation of Pinchot, Newell, Pardee and others and there is no doubt, moreover, that the Boise Congress was more largely attended by paid government officials than any meeting in its history. Government employees were so bold on this occasion as to deliberately hiss a United States Senator (Heyburn), who attempted to expose some of the fallacies of our forestry and reclamation bureaus. In those days Pinchot, as the personal representative of Roosevelt, was supreme, and would allow no one to stand before the delegates of the Congress and criticise the work of either the forestry or irrigation bureaus, if it could be prevented.

It should be remembered also that these Congresses were organized by people interested in conservation with the understanding that open discussion would result in general good to the western country. After mistakes began to be noticeable, however, and the delegates attempted to criticise, this band of "progressives," (all of whom were in the government employ and servants of the people,) got together and changed, or handled, the by-laws to suit themselves and no one was permitted to voice a protest; if by chance some individual delegate offered criticism, he was immediately attacked by the Pinchot-Newell crowd and, so far as possible, discredited ever after.

It transpired that Senator Carter had knowledge of many of the short-comings of both of these bureaus and being a United States Senator, could not be denied the priviledge of expressing his views, even in the presence of this august crowd. Hence, he was attacked on all sides and it was a great blow to them when he was made chairman of the Committee which was appointed to investigate the numerous charges by westerners whose interests were being effected. It was reasonable to suppose that in the appointment of this committee men favorable to both sides would be named, and it turned out, after a careful investigation, that many faults were brought to light and these were the matters that Senator Carter attempted to present to the public in the form of a report signed by a majority of the Committee. It can be readily understood, therefore, that the Reclamation Bureau would do all in its power to forestall an unsatisfactory report and their efforts seem to have been successful, in view of the fact that the report has not as yet come to light.

These facts are given briefly so that the readers of the Age may understand the antagonism of Chamberlain and others who were friends of Newell and his people, to the report being made public, and this brings to mind that a prominent engineer, who has been connected with the Reclamation Service for many years, one of the most competent men in the service in his day, stated to the editor of this journal recently that the report gotten out by the Board of Army Engineers, which has never yet reached our hands, supports every contention made by this journal as to the incompetency of Newell as the head of the Reclamation Service.

Those who have read the Age for ten or twelve years will remember the strong fight that was made against the methods of the reclamation people and it is our intention, later on, to publish extracts from the report of the Army Engineers which will verify the position of this journal in the past.

It is a pity that Senator Carter has been supplanted by another Montanian as it is doubtful now if the report will ever be made public. Senator Carter is not the man we think he is, however, if he allows this matter to remain inert. All of the facts contained in this report should be made public through the newspapers in the central and western states.

The Ambursen Hydraulic Construction Company of Boston have been employed as consulting engineers on a dam for the St. Stephens Land & Irrigation Company, who are developing a project on the Alamito river in Texas. The dam is 75 feet high and 1,000 feet long in its immediate construction, but is so arranged that it can be raised to a height of 100 feet to met future requirements.

Mr. Gilbert Altman, who has been connected with the United States Government as a chemist, has opened offices at 1028 First National Bank Building, Chicago, Telephone, Randolph 895. Mr. Altman makes a specialty of analyzing soils, fruits and vegetables.

John Hayes Hammond, the American mining engineer and promoter, is reported to be making extensive investigations in Russia to direct investments in irrigation and public utility companies. It is claimed that the Russian government will encourage the American enterprise.

Beautiful Lake Chelan

By J. S. Kirtley

Lake Chelan, in the state of Washington, is coming to be considered one of the World's most beautiful lakes. The fisherman finds it a paradise for cut-throat trout and other fish; the summer resorter and the nature lover combine to say its scenic attractions are entirely beyond the reach of pen or brush.

How that wonderful winding trough was ever made in the Cascade mountains, for almost a hundred miles, running from near the Columbia river north-westward, right into the heart of the highest mountains, we have to think back into the preglacial, volcanic ages, to conjecture. But there was a later time when a glacier filled it, going away down deeper than the sea level and extending far up to the mountain side, while still above it, towered higher heights. When the glacier melted the water filled up the bed, for fifty-one miles, leaving the upper part of the narrow valley to be drained by streams into the lake. And there it lies today, different from any other lake we have. The Kootenay up in Canada resembles it—in general outline. But I have made it my chief objective, in my travels, to get acquainted with our mountains and lakes and streams, and am prepared to defend Lake Chelan against all others of its size, for beauty in its formation and sublimity in its environment. Strip the Alpine Lakes of their artistic and literary and

Head of Lake Chelan.

historical traditions and associations and Chelan would go into the beauty contest without fear. Crater Lake is marvelous; little Lake Louise is without a peer for beauty; Spirit Lake at the foot of Mt. St. Helens, is a close second to Louise; but Lake Chelan is in a class of larger lakes and is at the head of the class. Starting in at Chelan, the southern point, you go northwest through a succession of Kaleidiscopic glories, each dissolving view succeeded by a more dazzling one, with every lurch of the boat forward towards the lake's head, in the snow-crowned and glacier-filled summits of the Cascades.

Outside of Washington, Chelan is scarcely known; inside not too well known. Last June the well-informed president of a great university confessed that he had never heard of it. This general ignorance is not wholly due to the modesty of those who live in its vicinity, but to the newness of a country full of clamorous beauty spots and to the remoteness of its railroads. It took us forty-three hours to get to the head of the lake from Seattle—165 miles by rail to Wenatchee; a wait for several hours and then forty-four miles by steamer up the Columbia River against a swift current, sometimes through raging rapids, to where the Chelan River brings down the outflowing waters of the lake; up four miles by stage to the town of Chelan; next morning by steamer fifty-one miles to Stehekin, the northern point. Mr. Edmunds and others, at Chelan, told me that Mr. James J. Hill has the right of way from his road at Wenatchee up to the lake and he seems about to build it every now and then, but, in a country where every place is shrieking for a railroad and competing lines must be watched, delays seem as inevitable as the railroad itself.

The approach up the Columbia gives one a chance to get into a geological and botanical frame of mind, though some, who rise early and start at six, may interpret that to mean that they feel rocky and green. The undulations above the banks of the river may almost make one forget that it is a canyon, the river is flowing through. It is, though. There, where the sagebush and greasewood begin to get reinforced

Winter Scene Lake Chelan.

by pine trees, a valley opens westward through the walls of the Columbia River canyon and the Chelan River comes down, making a descent of 325 feet in about four tortuous miles from the lake. In that short distance the river does pretty much everything, fantastic and furious, that a stream of its size could do. It begins with rapids that are always flecked with foam, whirls around cliffs, roars through gorges, impassible by man, a mass of snowy foam, and quiets down into its final race for the Columbia River. It has one hundred thousand horse power ready for Mr. Hill when he builds his road in there.

(Continued on page 841.)

Notes on Practical Irrigation

D. H. Anderson

Field's Hotel as Seen From Purple's, Lake Chelan Region, Washington.

Laying Out Land for Irrigation.

If the author had his way about it, he would have the land on each side of every main or large supply ditch sloped down gently for at least one hundred and fifty feet, and on that slope he would plant peas, beans, corn, and melons and raise a good profitable crop without any or with very little furrow or surface irrigation. The seepage water would answer the purpose of sub-irrigation, or infiltration, as will be explained in another chapter. This water aided by deep cultivation and pulverization of the soil would be sufficient to gratify his most ardent hopes.

At the bottom of each slope would be established an open ditch or covered drainage system, and the surplus water caught and utilized for surface or furrow irrigation on the plat below. The land on the ditch slope would be plowed and cultivated parallel with the ditch line, and at right angles to it on the plat below the slope.

This system of laying out the land is equivalent to terracing but more convenient and natural, withal, less expensive, for the ditches can be arranged to suit the slopes of the land rather than the reverse. Should the land be sufficient in quantity to make it worth while and the topography permit, a series of slopes could be provided for and every drop of the usually wasted seepage water utilized. It is very pretty to the eye and looks very nice and regular on paper, but the author believes that although the ditches run everywhere in the most profuse irregularity and ugliness, destructive even of the refinement required of landscape art, yet there is nothing more beautiful to his eye than a luxuriant crop of profitable plants. Experiment and settled practice has demonstrated the utility and value of this system all over the world. Corn, beans, peas, peppers, onions, even small fruits and crawling berry vines growing to perfect maturity without a drop of water from the clouds or by artificial application, and as to the quality—well, they are imported into this country from Europe and the American epicure pays three times as much for them as for home productions because he finds them better suited to his palate. Every housewife knows that her window plants flourish and grow luxuriantly by keeping the "saucer" of the flower pot filled with water without any surface wetting at all.

The system is as old as Egypt and Babylon, and it is adapted to small farms and is an obviously economical system of increasing the duty of water without increasing its quantity, and it is more conducive to the perfection of plant growth and life than "over-dosing."

Fourth of July Mountain, Lake Chelan.

Ditch-Bank Irrigation.

The system last referred to is really what may be called "ditch-bank irrigation." The object of it, of course, is to use the water that seeps or percolates from the banks of a raised ditch, which is sufficient to moisten the slope of the bank and the soil for some distance outward from the base. We find that this system was in favor with the old Spanish settlers, who opened a ditch from a stream on a grade so slight that a very slow flow would result. The land on each side of this ditch was thus moistened and almost every variety of vegetables and small fruits were raised without other irrigation.

To accomplish the purpose, the land is deeply plowed, turning under a good covering of manure, then harrow thoroughly until the soil is evenly settled. After this the land is ready for the elevated ditch from which the seepage water is to be obtained. This is done by throwing back a few furrows to form a ridge which shall be high enough to command the land under it. The ridge is shaped evenly and the surface raked over, a hoe being used to mark out a narrow ditch. When the water is turned in the course of the water may be regulated with a hoe and by a little cutting and filling, so that the water will run evenly along the entire length of the ridge.

In less than a week the soil along the ridge will be in a suitable condition to receive whatever seed or plant it is desired to grow; indeed, there will be as much space along the base of the ridge as there is on its slope which will be sufficiently moist. If the ground is not too porous, the water will percolate slowly and evenly and moisten the soil without cropping out at the surface anywhere. By thrusting the hand into the soil it will be found that the percolating water is within an inch of the surface, but never quite reaches it, due probably to surface evaporation. As will be noticed in the case of sand, the surface may be dry but water-soaked an inch or so below.

The number of ridges may be multiplied to suit the quantity of surface it is desirable to irrigate in that fashion, and they may be made large enough to control a quarter or half an acre. Even though the land at the base is perfectly flat, the water flows down the slope and spreads out along the levels. Should the land be sloping generally, the over-

flow from the first or highest ditch may be troughed to a lower one and so on indefinitely. Wooden troughs of four-inch stuff nailed together in the form of a V, with two or three cross-cleets at the top to prevent warping, are very serviceable, and being about sixteen feet in length, comparatively light, and therefore easy to handle, may be made to reach any desired distance by overlapping. Or, the overflow from a series of these ridge ditches may be collected into a ditch and carried to small fruits or joined with a large stream. The simplicity of the arrangement, though requiring some labor at first in establishing the proper grade, fairly compensates for that work and care, for during the rest of the season the irrigation is automatic, that is, it goes on uninterruptedly and without any assistance. All the repairs needed will be a few strokes of the hoe, a trifle of raking, and the land will always be ready for any kind of crop or succession of crops. Care should be taken not to puddle the bottom or sides of the ridge ditches, as in case of a reservoir. On the contrary the water should occasionally be shut off and the ditch raked up to open the soil, for the object of these ditches is not to store or hold water, but to enable the water to seep or leach out into the soil.

There is never any danger of the soil becoming soggy, for the quantity of water is small, regulated to suit the demands of the plants, and to allow for a slight evaporation.

Depressed Beds.

Growing out of the ditch-bank irrigation is the depressed or sunken bed system, which is quite similar, the water being fed from ridge ditches, but instead of percolating the water is run directly over and upon the soil after the manner of flooding. The land is not sloped but is flat, or level, a small flow, however, being desirable rather than objectionable. It is adapted to very light and unretentive soil and for shallow rooting plants like strawberries.

The land is laid out in rectangular checks, or any other desired form, and round the sides of the checks are elevated ridges upon the top of which are laid ditches in which the water flows slowly and quietly. The water is admitted to the checks from several points at the same time and distributes itself over the surface uniformly, slowly soaking into the soil.

In the hot summer months when it is desirable to maintain the growth of shallow rooted plants, it is an admirable system, and is enhanced in its effects by spreading over the soil a mulch of rotten straw, or coarse manure under which, protected from the sun, the water slowly spreads with very little evaporation. It possesses more beneficial aspects than mulching and sprinkling, for the reason that the water is retarded by the presence of the mulch from reaching the roots of the plants, where it is needed, and evaporation is much more rapid.

For the hot, dry season, where there is no danger of over-saturating the soil, the depressed bed is available for all kinds of vegetables, small fruits and flowers, the use of it showing marvelous results.

The system is in common use in Europe, where the heat is not excessive, and where a light sandy soil is under cultivation. It is the system adopted by the market gardeners in the sand hills south of the city of San Francisco, where the vegetable gardeners have transformed large areas of apparently worthless land into terraces, and on these have arranged depressed beds in which enormous quantities of succulent vegetables are grown for the city market. The water is raised by windmills and pumps from wells sunk in low spots, and delivered to small flumes which run from the windmill towers to the opposite hillsides. The water is flowed upon the highest terrace and conveyed thence by means of troughs and small ridge ditches from terrace to terrace and all the beds filled.

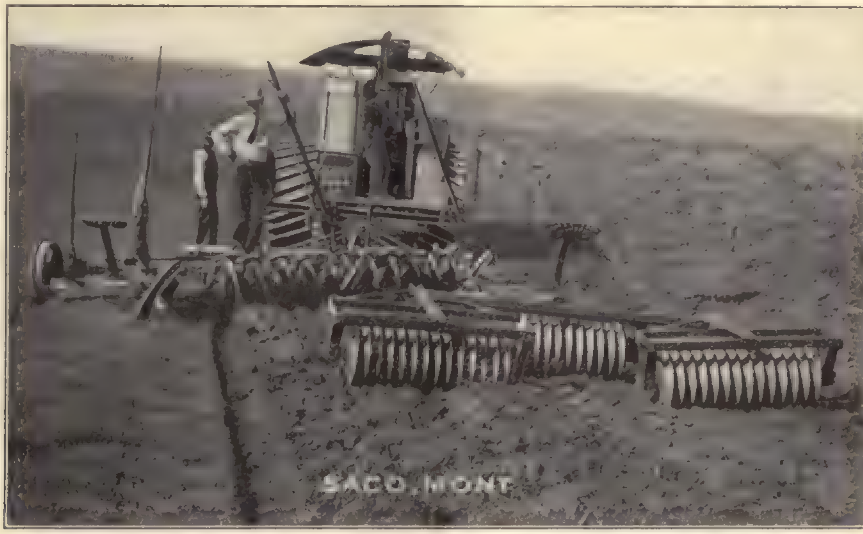
In all cases of surface or ditch irrigation the land must be laid out to suit the flow of the water, which is necessarily down hill, so to speak. If the land is not smooth on a level or slope, it must be leveled or graded by means of a scraper or other device for removing uneven portions and hillocks. If the land is too uneven to be irrigated uniformly, then sub-irrigation is the only remedy, or piping water to the tops of the ridges, or by establishing a reservoir on the highest spot, and thence running ditches in every direction after tracing or laying out the courses with the leveler as related in another and previous chapter.

As much care must be taken proportionately in field culture as in the case of small kitchen gardens, the principle being the same.

To put land in shape to irrigate it should first be plowed as deep as possible and then cut into beds of a larger or smaller size, depending upon the quantity of land to be irrigated and the amount of water at the disposal of the farmer. This may be done by means of a drag constructed in the shape of the letter A, from eight to twelve feet and more at the bottom, running to a point at the top. The land is dragged by drawing the A-shaped contrivance point first across the field from side to side. The wide spreading ends of the drag gather in the loose earth, clods and other rough material and heap them up behind in the shape of a ridge. These beds may be made from sixteen to eighty feet wide and ten to forty rods long; it all depends upon the quantity of water at hand to fill them.

After the field has been laid off into beds, the ground between the ridges must be leveled if uneven or humpy, and for this purpose a scraper will be serviceable. By it the humps should be scraped into the low places, and then

(Continued on page 840.)



Hart-Parr Engine, Owned by Armstrong Live Stock Co.—Breaking Gumbo near Saco, Mont.

This engine is hauling a ten disc Emerson Engine Gang Plow. The sub-surface packer is so set as to pack the ground twice as it laps one-half. The ground in the center of the picture shows the effect of this combination while that at the extreme right where no packer was used gives the contrast and shows the great value of doing the work in this way. By packing the ground twice with a sub-surface packer as it is plowed capillary connection is restored and a surface mulch made thus breaking the sod and preparing an excellent seed bed at one trip. It is in such ways as this that one gets the most good from the epoch-making Modern Farm Horse.

ARID AGRICULTURE

BY

B. C. BUFFUM, M. S.

Manager of the Wyoming Plant and Seed Breeding Company, Worland. Former Professor of Agriculture in the University of Wyoming and the Colorado Agricultural College, and Director of the Wyoming Agricultural Experiment Station.

POTATO CULTURE.

Prof. B. C. Buffum.

Potatoes can be produced with as little moisture as any of the general farm crops. Their requirements are such that a little water stored in the soil will make sufficient growth of vine, and with proper cultivation its feeder roots will gather practically all the moisture in the cultivated area. The potato is one of the most important and profitable arid region productions. So important has it become under irrigation in certain sections that its culture is being rapidly extended. When grown under irrigation the potato is

John Gorden and His Dry Farm Potatoes.

forced and rapidly deteriorates as seed. On this account there is large demand for potato seed raised by dry farm methods. Seed raised by dry farming, and used under irrigation, seems to do well the first and second years, but old potato growers seldom use the same seed the third year. This is an important item to the dry farmer who has soil and conditions suitable for potato culture.

Good crops of potatoes are raised on a variety of soils. We believe a light sandy loam is preferable, but where late water can be supplied, good crops are produced on heavier soils. With proper cultivation the yields average from 100 to 250 sacks of two bushels each per acre. The cost of producing the crop averages about thirty dollars per acre.

The main croppers in the mountain region are the "Ohio" for early crops, the "Mammoth Pearl," and "Rural New Yorkers" for late crops. In some sections the "Burbank" does very well. Early varieties are more used for dry farming, but very few early potatoes are grown as main crops by irrigation. The white varieties (Pearl and Rural) take the lead. It is important that a community of farmers who are just becoming established, at least, plant only one or two varieties in order that they may supply a uniform product to the market in sufficient quantities.

Potatoes on the YU. Ranch, Big Horn County, Wyo.

The root rot (See future articles on Plant Diseases) and blight are very common potato diseases and the first of these, at least can be measurably controlled by properly handling and treating the seed before planting, by change of seed and by rotation of crops. Seed potatoes may be kept from sprouting in the spring by frequently changing their position in the root cellar. Perhaps one of the best treatments that can be recommended is to let them become well sunburned. The light seems to destroy the winter stage of the root rot disease. The farmer can tell whether this disease is present in abundance on his potatoes by the presence of black spots, which look like particles of soil that stick very tightly to the skin of the potato. "Greening" the potato seed also causes short, strong sprouts which do not break off in handling and are ready for business as soon as planted in moist soil.

Treatment with corrosive sublimate or formalin will also help destroy this disease, and it is a cure for true potato scab where the crop is raised on clean land. Use two ounces of corrosive sublimate to fifteen gallons of water. Dissolve the corrosive sublimate in one gallon of boiling water, using an earthen or glass jar. Mix with water in a barrel and dip the potatoes, leaving them in the solution one to one and one-half hours. Spread out to dry before cutting. Corrosive sublimate is a deadly poison and must be handled with great care. Never use the same vessel for any other purpose.

Small potatoes may be used for seed if they are pure and true to type, and will give as good results as will planting larger tubers. They may be either planted whole or cut, one or two eyes to the piece. The best results in cutting have been obtained by quartering the potato lengthwise, and if a cutting block is used, the larger ones may be quartered by splitting both ways. Where potatoes are planted on a large scale a machine cutter may be used.

Seed potatoes should be pure varieties, true to type, and not forced by irrigation. It is more important that the seed potato be one from a thrifty hill which contains a good number of potatoes true to type than that it be large size. The best seed for irrigation is raised by dry farming or at high altitudes in the mountains. The seed should be as free as possible from scab and the root rot disease, must not get chilled or frosted, and should be changed often where there is tendency to run out. A farmer who would raise potatoes successfully must not hesitate to pay the price for the best potatoes to renew his seed.

Potato ground must be plowed deep. Usually four horses are put on to a fourteen-inch plow and the furrow turned eight or ten inches deep. If on sod ground, five or six inches will do the first year. The ground should be harrowed the same day it is plowed and the plowing should not be done long before planting time. Sod ground should be disced before plowing is commenced in order to make as fine a seed bed as possible after it is turned under. Alfalfa ground to be used for potatoes must be plowed deep and a wide, sharp share used to cut off the roots.

The best results are obtained by the use of a good potato planter, and such machinery is necessary, if potatoes are to

Potatoes on the Y U Ranch, Big Horn County, Wyoming.

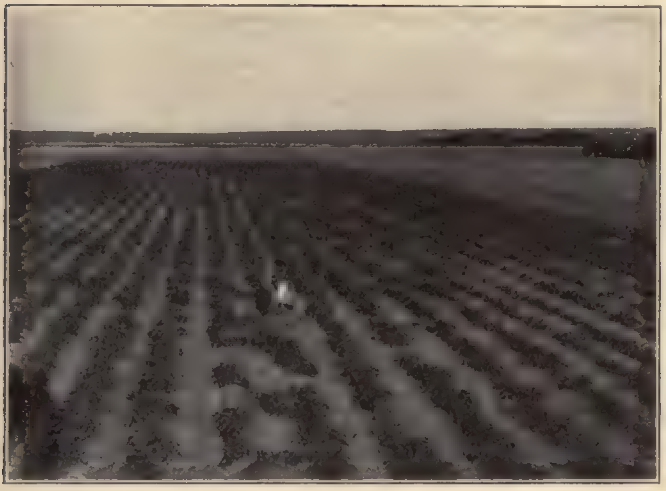
be raised on a large scale. The seed should be put in an average depth of four inches when on dry, sandy soil, though they may be planted six or seven inches deep and still give good results. They are not planted deep enough as a rule. Immediately after planting, a good four-horse cultivator should be run through between the rows, loosening the ground to the depth of the plowing, or, if possible, an inch or two deeper than it was plowed. Use a four-horse cultivator and run the shovels close to the rows. Follow the cultivator with the harrow to level the soil and establish the mulch. Just before the potatoes come through the ground, give a second harrowing with a toothed harrow, slanting the teeth a little back. The seed may be dropped distances of from twelve to eighteen inches apart in the row and the rows should be from three to three and one-half feet apart. From five hundred to seven hundred pounds of seed per acre is sufficient. At higher altitudes, where the season is short and potato vines make comparatively small growth, they may be planted correspondingly closer together with the required increase in the amount of seed. The largest yield of which there is any authentic record in the West was obtained from potatoes planted a distance of eight inches apart in rows two and one-half feet apart, on highly fertilized and cultivated ground.

Potatoes should receive deep and thorough cultivation. When the plants are four or five inches high, cultivate deep and near the rows. This should be done each week or ten days, running the cultivator shovels farther from the plants as they grow larger, and throwing the soil toward the rows. The ground should be kept well stirred to the depth of the plowing between the rows until time for irrigation. Each irri-

gation should be followed by shallow cultivation to break up the crust until the vines get so large they interfere.

Potatoes should not be irrigated until after the young tubers are set on the vines, though where the season is so dry they burn, it may be necessary to irrigate at any time. The tubers usually set a week or ten days bofere the plants begin to bloom. Deep ditches should be made with a double plow, between the rows, and the first watering should be very light. Run the water in the alternate rows and in a week or ten days run a good head quickly through the rows which were not irrigated before. This should be followed in from a week to twelve days with a thorough soaking up of the ground, running the water between each of the rows, but do not let it stand too long. Water should never come in contact with the crowns of the plants. If a large crop is the principal consideration, the potatoes should be irrigated once in a week or ten or twelve days through the season after starting, as indicated above. They must not be allowed to get dry enough to check their growth. After the growth becomes checked once, new irrigation will start second growth, which produces large vines, new setting of tubers or knotty, ill-shaped potatoes. If it can be avoided, irrigation should not be done when the weather is hot and sultry.

Farmers who make a business of potato raising follow a regular system of rotation in which alfalfa is the crop used to bring back the soil fertility. Potatoes do well on sod land and one or two crops may be raised. This should be followed with a crop of grain, and if the soil conditions are favorable,



John Gordan and His Dry Farm Potatoes, Wyoming.

alfalfa may be sown with the grain. The alfalfa is left in the ground two or three years. It is then plowed late in spring after the alfalfa plants have started. This plowing is difficult and must be thoroughly done. The deep cultivation immediately after plowing will pull out the principal roots and prevent their interfering with future cultivations or ditching for irrigation. Such alfalfa ground may be kept in potatoes two years if disease does not appear, and then put back into alfalfa with grain. Field peas are an excellent crop to rotate with potatoes in dry farming or under irrigation. Plowing under a light crop of peas in Wyoming increased the potato crop thirty-one dollars per acre. Potato ground is usually in fine condition for any following crop.

Potatoes may be grown without the use of special machinery, but if any acreage is raised, it is economy to have the best equipment. There are a number of planters on the market. Some of the different makes are the Robins, Aspenwall, Superior, Evans and Excelsior. Digging may be done with a potato plow, which has fingers behind, which are worked by a shaker, or with the larger machines, like the Doubon or Brown. The potatoes may be sorted by hand when picked up, or all picked into a basket and run over a wire screen sorter. Where the potato beetles are troublesome, it is necessary to have some form of spraying machine to treat with Paris Green.

Potatoes are usually left in the ground some time after frost has killed the vines in the fall. This helps to ripen and dry out the tubers. They should be harvested before the ground begins to freeze. Where the potatoes are green, care should be exercised in handling and a sorter should not be used. If they are to go to market at once they are sorted and sacked in two bushel sacks. If they are to be held for a short time and a root cellar has not been prepared, they may be pitted in the field. Do not dig deep pits, but smooth off the ground, put the potatoes in as steep a pile as possible, cover first with straw or vines and then with enough soil to prevent injury by frost. Leave a small space at top of pile not covered with the soil for the escape of the heat and moisture given by piled potatoes. Potatoes stored in this

A Good Potato Crop.

way will keep until the weather gets quite cold. Where root cellars are used, the potatoes are usually piled in loose, and kept as cool as may be without danger of freezing.

Often our potatoes grow to very large size, single tubers weighing five and siz pounds not being uncommon. These very large potatoes are not desired in the market. The best sale is found for a medium-sized potato which will give from sixty to seventy-five potatoes per bushel of sixty pounds. Such potatoes are desired by hotel and restaurant-keepers for baking purposes. The farmer who properly grades his produce will always find ready demand and good prices. Uniformity in size and color, freedom from scab, crack or dirt, shallow eyes and pleasing shape are essential to secure top prices for the product.

ALFALFA GROWING.

By O. A. Thompson.

For the past few years, farmers of the Northwest have manifested great interest in alfalfa growing. This interest has been brought about by two factors which are of vital importance to the farmer, scarcity of forage for stock and the declining fertility of the soil. Recognizing the great economic importance of this peer of forage crops, the farmers have sought to supply the deficiency of forage and at the same time build up their worn out soil by trials in growing alfalfa, which have in many instances proven a failure.

The many factors which enter into successful alfalfa growing, especially in the semi-arid west, make it imperative that a thorough study of the nature and requirements of the crop be made before attempting to grow it. Should these essential factors be disregarded, the attempt to grow alfalfa will prove disappointing and will result in sure failure.

Conclusions drawn from the best results in alfalfa growing at the Edgeley Experiment Station and the experience of successful growers of the crop, lead to the following observations: Alfalfa will do well on nearly all well drained soils, but it thrives best on a rich sandy loam with a permeable subsoil. The old saying, "that alfalfa will not stand wet feet," is very true as many have found to their sorrow in attempting to grow it upon wet, soggy land. Alfalfa will stand some flooding while the plants are in the dormant state, but sheets of ice invariably kill out the crop. Hence the desirability of making the proper selection of fields intended for alfalfa.

Land intended for alfalfa growing must be thoroughly prepared by good, reasonably deep plowing and harrowing and should be practically free from weeds. It is a waste of time and money to attempt to grow alfalfa upon poor weedy land as the young plants are very tender and a poor stand is usually the result. It is an excellent plan to prepare the land the year previous to sowing the alfalfa by growing a cultivated crop such as corn or potatoes, the latter preferred. Here is where the good plowing and thorough tillage should be practiced. By thoroughly cultivating the land, many of the weeds are destroyed and a large amount of moisture is stored in the soil to be utilized by the young alfalfa plants. Upon old land, a liberal application of well rotted manure before planting the cultivated crop will prove very beneficial in stimulating vigorous growth while the plants are young. Before sowing the alfalfa the following spring, the land should be double disced by lapping half and then thoroughly harrowed. It is highly important that the soil be put in the best possible physical condition before sowing the seed.

Alfalfa should be sown in the spring after the danger of heavy frost is past. In the drier sections, better stands are generally obtained when medium early seeding is practiced. Usually, better stands are obtained by sowing the seed broadcast and lightly harrowing the ground after sowing. More seed will be required for broadcasting than when a drill is

(Continued on page 838.)

THE PRIMER OF HYDRAULICS*

By FREDERICK A. SMITH, C. E.

8. *The circle and its properties.*

The circle is an uniformly curved line, each point of which has the same distance from a point within called the center. Thus in Fig. 31 let *O* be the center of the circle, draw any line *OA* to the circumference of the circle, then *OA* is called a radius; draw another radius *OB*, then *AO* = *BO*; the part of the circle line lying between *A* and *B* is called an arc, and the angle *AOB* is called a central angle, spanning arc *AB*; a straight line *AB* is called a chord. Equal chords span equal arcs and equal central angles. Thus, if *AB* and *CD* are equal, then the arcs *AB* and *CD* are equal, and the central angles *AOB* and *COD* are also equal. The area inclosed between two radii and an arc is called a sector, and the area lying between a chord and arc is called a segment. Thus sectors and segments of equal central angles or having equal arcs or chords in the same circle are equal.

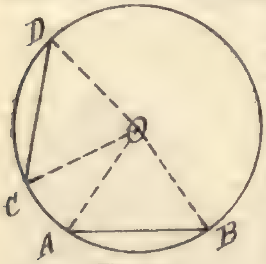


Fig. 31.

If a line *ST* is drawn so as to touch the circle line in just one point *A* as indicated in Fig. 32, it is called a tangent, and if *A* is connected to *O* then *AO* stands perpendicular to *ST* in point *A*. A line like *CD* which cuts the circle line in two points *E* and *F* is called a secant. A chord *GH* passing through the center of the circle is called a diameter. An angle like *AHG* having its vertex in the circumference of the circle is called a periphery angle and is equal to ½ of the central angle *AOG*, both standing over the same arc *AG*; thus central angles are measured by the full arcs and periphery angles by ½ of the arcs upon which they stand. Any periphery angle standing over the diameter is consequently equal to 90°.

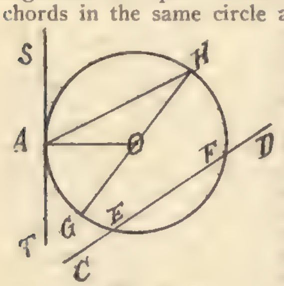


Fig. 32.

Thus in Fig. 33 if *AB* is a diameter then angle *ACB* = 90°; no matter which point of the circumference is connected with the ends of a diameter it always gives a right angled triangle as *ADB*.

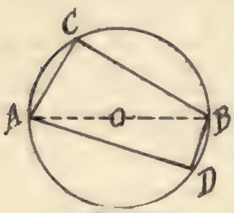


Fig. 33.

The ratio of the circumference of a circle to its diameter is the decimal fraction 3.1416; this number, which is also called π (pi), is very important and enters in all circular problems, so that it should be known by heart; for ordinary work the fraction 3.14 or 3 1-7 may be used. Thus if the diameter of a circle is given the circumference is formed by multiplying the diameter by π; inversely the diameter of a circle is found by dividing the circumference by π. Thus let the diameter of a circle be 3 ft., then the circumference equals 3 × 3.14 = 9.42 ft. To find the diameter of a circle having a circumference of 10 ft., divide 10 by 3.14 = 3.184 ft.

The area of a circle is found by multiplying the square of the radius by π. To illustrate their relations by formulae let $\pi = 3.1416$, the circumference p the radius r and the area a, then the following formulæ obtain:

$p = 2\,\pi\,r$. (1.)

$a = \pi\,r^2$. (2.)

$r = p/2\,\pi$. (3.)

$r = \sqrt{a/\pi}$. (4.)

Applied problems.

1. What is the circumference of a circle having a radius of 5 inches?

Solution. Substitute in formula 1 the given quantities, then: $p = 2 \times 3.1416 \times 5 = 31.416$ inches.

2. What is the area of a circle having a radius of 5 inches?

Solution. Substitute in formula 2 the given quantities: $a = 3.1416 \times 5^2 = 3.1416 \times 25 = 78.54$ square inches.

3. What is the radius of a circle, having a circumference 31.416 inches?

Solution. Substitute the given quantities in formula 3: $r = 31.416 \div 2 \times 3.1416 = 5$ inches.

4. What is the radius of a circle having an area of 78.54 square inches?

Solution. Substitute the given quantities in formula 4:

$r = \sqrt{78.54 \div 3.1416}$.

$r = \sqrt{25} = 5$ inches.

5. Find the diameter of a cast iron pipe having a cross sectional area of 32 square inches.

Solution. Here the area is given and the radius wanted, so use formula 4 and substitute the given quantities:

$r = \sqrt{32 \div 3.1416}$.

$r = \sqrt{10.186} = 3.191$ inches.

This makes the diameter 2×3.191=6.382 in., or 6⅜ inches.

5. Find the area of a Segment in a circle, Fig. 34, having a radius of 3 ft. and in which the central angle *ACB* = 90°.

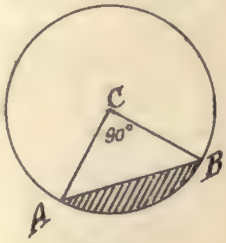


Fig. 34.

Solution. The area of the whole circle is equal to $\pi\,r^2$; hence the area of Sector *ACB* = $\pi\,r^2/4$; the area of triangle *ACB* = $r^2/2$, hence the area of the segment equals $\pi\,r^2/4 - r^2/2$; substitute given values:

1. *Principles and Definitions.*

$3.1416 \times 3 \times 3 \div 4 - 3 \times 3 \div 2$.

$7.0686 - 4.5 = 2.5686$ square ft.

Article IV. Trigonometry.

Trigonometry teaches how to compute the sides and angles of triangles. In Fig. 35, let *ABC* be any angle α and draw from any point *A* a line *AD* perpendicular to *BC*, then *ABD* is a right angled triangle; drop another perpendicular *E F* from any point *E*, then *E B F* is also a right angled triangle, and the two triangles are similar; hence:

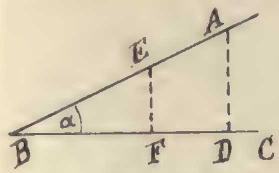


Fig. 35.

$EF : BE = AD : AB;$

also $BF : BE = BD : AB;$

also $EF : BF = AD : BD$, and

$BF : EF = BD : AD.$

No matter where a perpendicular might be drawn parallel to *A D*, the above ratios remain the same so long as the angle α remains the same; it is also seen as soon as the angle α changes then the ratios of the sides change also; thus the ratio *EF/BE* changes for every degree of angular measure of α, and if a table be computed giving the value of this ratio for all the degrees of angle from 0° to 90° we can from such table draw conclusion as to the value of the angle if the sides *EF* and *BE* are known, or we can find the sides when the angles and one side are given.

These ratios of the sides of a right angle triangle are called trigonometric functions and are shown in a table embodied in this work.

2. *The Functions.*

In Fig. 36 let the angle *ACB* = 90°, and let the sides of the triangle be a, b and c respectively, then the following ratios can be formed between the 3 sides:

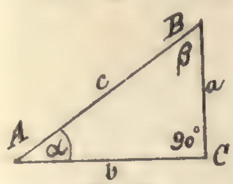


Fig. 36.

a/c = sinus α, abbreviated sin α

b/c = cosinus α, abbreviated cos α

a/b = tangent α, abbreviated tg α

b/a = cotangent α, abbreviated cotg α

c/a = secant α, abbreviated sec α

c/b = cosecant α, abbreviated cosec α

The secant is the reciprocal of the cosine and the cosecant is the reciprocal of the sine, and both are but little used.

If the side c is = 1 then the side a is the sine and the side b is the cosine of α; in the relation to angle β the side a is the cosine and the side b the sine of β; since α and β are complementary angles it is seen that:

$\sin\alpha = \cos\beta$

$\cos\alpha = \sin\beta$

$\mathrm{tg}\ \alpha = \mathrm{cotg}\ \beta$

$\mathrm{cotg}\ \alpha = \mathrm{tg}\ \beta$

Thus it follows that for instant, sin 1° = cos 89°, or tg

$2° 20' =$ cotg $87° 40'$, etc., hence the trigonometrical tables have been prepared so that every function for every angle is the cofunction of the complement.

3. *Transmutation of Functions.*

In Fig. 36, when $c = 1$, then a is the sine and b the cosine of α; and since $a^2 + b^2 = 1$, then

$a = \sqrt{1 - b^2}$ and $b = b\sqrt{1 - a^2}$, so that

$\sin\alpha = \sqrt{1 - \cos^2\alpha}$ and

$\cos\alpha = \sqrt{1 - \sin^2\alpha}$

also $\text{tg}\,\alpha = a/b = \sin\alpha \div \cos\alpha$

also $\text{cotg}\,\alpha = b/a = \cos \div \sin\alpha$

also $\text{tg}\,\alpha = 1/\text{cotg}\,\alpha$ and

$\text{cotg}\,\alpha = 1/\text{tg}\,\alpha$

So to express the tangent a in sin α, substitute value of cosine as above:

$$\text{tg}\ \alpha = \sin\alpha \div \sqrt{1 - \sin^2\alpha} \text{ or}$$
$$\text{tg}\ \alpha = \sqrt{1 - \text{Cos}^2\alpha} \div \text{Cos}\ \alpha; \text{ also}$$
$$\text{cotg}\,\alpha = \cos\alpha \div \sqrt{1 - \cos^2\alpha}\ a$$
$$\text{cotg}\,\alpha = \sqrt{1 - \sin^2\alpha} \div \sin\alpha.$$

4. *The Signs of the Functions.*

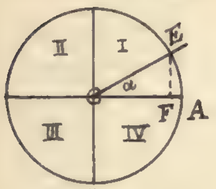


Fig. 37.

In Fig. 37 a circle is divided into 4 equal sections, called quadrants, let the radius OA equal 1 and let a moveable radius OE be journalled at point O, so that as it turns from the position OA upward through the 4 quadrants it will describe all the angles possible from zero to 360°; the angles in the first quadrant run from 0° to 90°; in the second quadrant from 90° to 180°, in the third quadrant from 180° to 270°, and in the 4th quadrant from 270° to 360°; but the trigonometrical functions are numerically the same in all the quadrants; thus if the angle $\alpha = 10°$ then its sine $E\ F$ is also the sine of 170°, the sine of 190° and the sine of 350°, but the signs of the functions are differing in the different quadrants; hence the functions of the angles have been computed only for one quadrant.

The signs of the various functions are indicated in the following table:

Functions	Quadrant 1	Quadrant 2	Quadrant 3	Quadrant 4
Sines	+	+	—	—
Cosines	+	—	—	+
Tangents	+	—	+	—
Cotangents	+	—	+	—

It is seen that all the functions are positive in the first quadrant and that in the second quadrant the sine is positive, but the cosine tangent and cotangent are negative.

The signs of the secant are the same as that of the cosine, and the signs of the cosecant the same as that of the sine.

5. *Numerical Limits of the Functions.*

By watching the moving radius in Fig. 37 it is seen that $E\ F = 0$ when $\alpha = 0$, so the sine of angle of $0° =$ = zero and grows as the angle grows, and reaches a maximum of 1.0 when $\alpha = 90°$; the cosine of $\alpha = 1$ when $\alpha = 0°$, and decreases as the angle increases, reaching 0 when $\alpha = 90°$. Likewise the tg $\alpha = 0$ when $\alpha = 0°$; the tangent grows as the angle grows and becomes infinitely large when $\alpha = 90°$.

The cotangent is the reverse of the tangent; when $\alpha = 0°$ the cotangent $= \infty$ (infinitely large), as the angle grows the cotangent decreases, and when $\alpha = 90°$ the cotangent $= 0$.

It is also seen that when $\alpha = 45°$, then the tangent and cotangent are each equal to 1 and the sine and cosine each equal to $\sqrt{.5} = .7071$. In a 60° triangle the cosine of an angle of $60° = \frac{1}{2}$.

6. *Application to Practical Problems.*

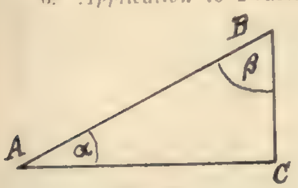


Fig. 38.

In the right angled triangle ABC, Fig. 38, let $AB = 17$ ft., $AC = 12$ ft.; find side BC and angles α and β.

Solution. The sine of the angle $\beta = AC/AB$ or $12/17 = .70588$; look in a table of natural sines and opposite .70587 you find 44° 23', which is the right angle to the nearest minute; then since $\alpha + \beta = 90°$, then $\alpha = 90 - \beta$, or $\alpha = 90° - 40° 23' = 45° 37'$.

(Continued on page 833.)

Supreme Court Decisions

Irrigation Cases

DAMAGES FOR FLOODING LANDS—

The measure of damages for injury to land, by its being covered with sediment and debris by being flooded by the breaking of a reservoir, is the difference between the value of the land before and immediately after the injury and not the reasonable cost of clearing the land, though evidence of such cost would be admissible to aid in determining such difference in the value of the land. *Mustang Reservoir, Canal & Land Co.* v. *Hissman.* Supreme Court of Colorado. 112 Pacific 800.

DAMAGES FOR FLOODING LANDS—

In an action for damages by the flooding of plaintiff's land by the breaking of defendant's reservoir, evidence that about eight or ten months after the flooding plaintiff expended a certain sum in repairing his reservoir embankment was not of itself sufficient to authorize the allowance of damages on that ground; there being no evidence to show that the repairs were made necessary by the flooding, or that the amount expended was reasonable, or as to the actual damage to the reservoir embankment. *Mustang Reservoir, Canal & Land Co.* v. *Hissman.* Supreme Court of Colorado. 112 Pacific 800.

RESERVATION OF WATER—

Plaintiff whose land was bordered by a stream conveyed water to his residence by means of a flume and thereafter he conveyed a strip of land bordering on the stream, and the deed reserved the right to "take and use the water as now taken and used" and the right to repair and maintain flumes "necessary to conduct the amount of water now accustomed to flow across the lands conveyed." *Held*, that plaintiff's rights were limited to the amount of water used by him at the time of conveyance, irrespective of the amount that flowed in the flume. *Peterson* v. *Cody.* Court of Appeal, First District, California. 112 Pacific 558.

REASONABLE CHARGE—

What is a reasonable charge for irrigation within Laws 1907, chap. 49, regulating the use and distribution of water for irrigation, and providing that the charges therefor shall be reasonable, depends largely on the cost of constructing and operating the irrigation works, and the price which the owners of land can afford to pay for irrigation must depend in part on the use to which the land can be put.—*Young & Norton* v. *Hinderlider.* Supreme Court of New Mexico. 110 Pacific 1045.

DOCTRINE OF APPROPRIATION IN COLORADO—

In Colorado, the common-law doctrine in respect of the rights of riparian proprietors never has obtained, and in its stead there was adopted the doctrine of appropriation which regards the waters of all natural streams as subject to appropriation and diversion for beneficial uses and treats priority of appropriation and continued beneficial use as giving the prior and better right.—*Snyder* v. *Colorado Gold Dredging Co.* U. S. Circuit Court of Appeals. 181 Federal 62.

IRRIGATION CORPORATION'S LIABILITY—

A corporation organized under Sayles' Ann Civ. St. 1897, art. 3125, providing for irrigation corporations with power to sell water to consumers pro rata, without preferences, which contracts with a person entitled to water for irrigation to furnish him with a full supply of water to make a crop, cannot excuse nonperformance by proving shortage in the supply from drought, accident, or other causes, so that it cannot comply with the contract without discriminating against other consumers of water.—*Erp* v. *Raywood Canal & Milling Co.* Court of Civil Appeals of Texas. 130 Southwestern 897.

PATENT FOR GOLD PLACER AND UNAPPROPRIATED WATER—

In so far as the rights and incidents of riparian proprietorship are concerned, conveyances by the United States of public lands on nonnavigable streams and lakes, when it is not provided otherwise, are to be construed and have effect according to the law of the state in which the lands are situate; and by the law of Colorado a conveyance of riparian land, even if it be a gold placer claim, does not carry any right to the unappropriated waters of the stream.—*Snyder* v. *Colo-*

rado Gold Dredging Co. U. S. Circuit Court of Appeals. 181 Federal 62.

IRRIGATION LICENSE BY STATE ENGINEER—

Laws 1907, chap. 180, provides for the issuance of licenses by the state engineer to appropriate water for irrigation purposes, and section 15 provides that an ordinary suit may be maintained to adjudicate conflicting water rights in any court of record. Section 19 requires that a petition for a license shall be filed with the state engineer, and section 20 declares that the date of receipt be indorsed on the petition, and noted in the record, and, if the application is defective, it shall be returned for correction within 30 days, and that 60 days shall be allowed for refiling, in which event the application shall take priority as of the date of original filing. Section 21 provides for publication of notice, and that proof of publication shall be filed with the state engineer within 60 days of the date of his instruction to make publication, and that, in case of a failure to file such satisfactory proof, the application shall be treated as an original application filed on the date of receipt of proofs of publication. *Held*, that where the state engineer granted an appropriation license as of the date of filing the petition, notwithstanding a failure to file proof of publication within the time provided, such failure did not deprive the engineer of jurisdiction; and hence his decision as to such priority could not be reviewed on certiorari.—*Geiger* v. *Lea, State Engineer.* Supreme Court of South Dakota. 128 Northwestern 139.

REVOCATION OF DITCH LICENSE—

Defendant, acting as owner of land, having granted plaintiff a license to construct a ditch through it, and having thereafter acquired the title, while recognizing the right of plaintiff, who, supposing the land belonged to defendant, had at great expense partly constructed the ditch, is estopped to revoke the license, the same as though he had been the owner when he granted it.—*Shaw* v. *Profitt.* Supreme Court of Oregon. 110 Pacific 1092.

APPLICATION FOR PERMIT TO APPROPRIATE WATER—

The cost of a proposed irrigation project, though not conclusive on the question of public interest within Laws 1907, chap. 49, sec. 28, authorizing the territorial engineer to reject an application for premit to appropriate waters if in his opinion the approval would be contrary to the public interest, must be taken into consideration in determining whether the application shall be granted or rejected.—*Young & Norton* v. *Hinderlider.* Supreme Court of New Mexico. 110 Pacific 1045.

IRRIGATION CORPORATION—

A promoter of an irrigation corporation, who acquired a right to purchase land through one who had a contract to purchase at $5 an acre, cannot recover damages from the corporation on the ground of fraud, because on forfeiture of the contract the corporation bought the land directly at about that price, where the promoter sought without actual investment of money to make a large profit by a sale to the corporation at $30 an acre.—*Mangold* v. *Adrian Irrigation Co.* Supreme Court of Washington. 111 Pacific 173.

IRRIGATION PROJECTS—

That a later project for irrigating land is better within the available water supply than a prior project is no reason why the territorial engineer should not, under Laws 1907, chap. 49, regulating the use and disposition of water for irrigation, approve the earlier project for the amount of land there is water for.—*Young & Norton* v. *Hinderlider.* Supreme Court of New Mexico. 110 Pacific 1045.

CONVEYANCES—

A conveyance by an owner of land of his riparian and water rights and privileges belonging to the land, except necessary water for domestic purposes, transfers to the grantee not only riparian rights, but all water rights which belong to the land, except the rigths reserved, and transfers the right of the grantor to apply the waters to his land, except for the reserved uses.—*Duckworth* v. *Watsonville Water & Light Co.* Supreme Court of California. 110 Pacific 927.

Avery Steam Shovel owned by Handly & Spangler, St. Charles, Mo., at work on their farm, building a levee. This outfit is manufactured by the Avery Company, Peoria, Ill., and is used also for irrigation work, drainage, street excavating, stripping coal, etc. In the April issue of this journal will be shown a fine ditch opened out by this outfit.

SPRAYING FOR PEACH FRUIT SPOT.

A. B. CORDLEY AND C. C. CATE.

The disease which is known by Oregon peach growers most commonly as "peach fruit spot" and also as "fungus," "shot-hole fungus," "peach spot" and "brown spot," has been in evidence for many years, during the past few of which it has occasionally caused no little loss. In some instances the crop has been so spotted that it could not be disposed of on the open market, and many tons of otherwise luscious fruit have been forced to the canneries or evaporators. Still more unfortunate is the fact that often a portion of the infested fruit is worthless and is left to decay on the trees and in the orchard, thereby harboring and spreading the disease so that year by year it may secure a firmer and surer hold upon each succeeding crop.

Under date of August 2, 1906, M. A. L. Kitchen, manager of the Ashland Fruit and Produce Association, forwarded to us a box of badly infested Hales Early peaches with the accompanying statement: "Many of our peaches this year are affected with a disease which causes spots on them much resembling scale." Later so many similar reports were received from most of the peach growing sections of the state that we decided to undertake a study of the disease and of the best methods of controlling it.

The spraying experiments which were begun in the spring of 1907, were conducted the first season in co-operation with Mr. Benton Bowers, who contributed the use of his orchard near Ashland. During the two succeeding seasons the work has been continued in co-operation with Mr. Albert Joy, who purchased the orchard of Mr. Bowers. To both Mr. Bowers and Mr. Joy we desire to express our hearty appreciation for the many courtesies extended.

The orchard in which the work was done consists of about twelve acres of fifteen-year-old trees, mostly Muir, with some Albertas and Crawfords. It is well located, with a gentle slope to the northeast, and the soil which is deep and of the decomposed granite type is considered excellent for peaches. Nevertheless the trees had generally been neglected, very little, if any, spraying had ever been done and we were told that the orchard had never produced a profitable crop—such fruit as had been produced having been "spotted" and of but little value.

The object of the experiments was to compare the efficiency of Bordeaux mixture and lime-sulphur in controlling the disease; and to determine the number of applications necessary and the best times at which they should be applied. During the first season's work the lime-sulphur was used only for the first application before the buds started in spring, but during all the later experiments it has been tested as well for the summer applications.

Fig. II. The So-called "Culls" from Sprayed Trees Could Have Been Marketed as Second Grade Fruit.

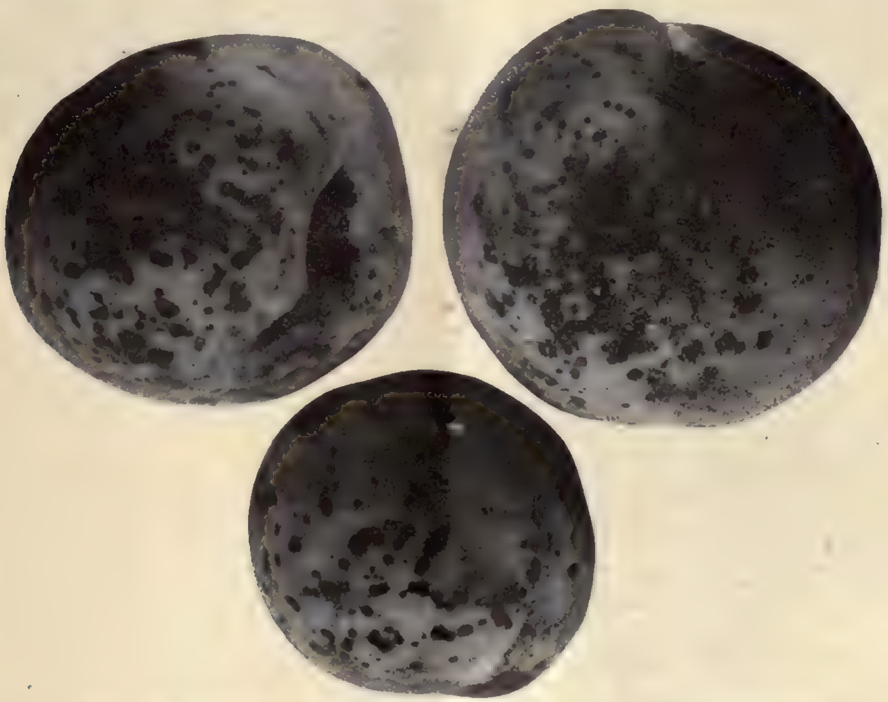


Fig. I. Much of the Fruit from the Unsprayed Trees Was Practically Worthless.

Work in 1907.

The first application in 1907 was made between February 27th and March 4th, just as the first buds were swelling. A block of about two acres was sprayed with Bordeaux mixture and the remainder with Phoenix lime-sulphur solution. Later the two acre block, which comprised thirteen rows across the north end of the orchard, was subdivided into plots for the purpose of determining the relative efficiency of several different methods of treatment.

In the following table, which is intended to show the treat-

ment given each plot and the results obtained, the various plots are numbered from one to thirteen, while the columns which represent the various applications are lettered from A to D as follows:

"A" represents the first application made February 27 to March 4.

"B" represents the second application made April 30.

"C" represents the third application made May 15.

"D" represents the fourth application made June 1.

"E" shows per cent of infested fruit at picking time.

The first application was made just as the buds were swelling; the second soon after the blossoms fell; the third when the fruit was about one-half inch in diameter; and the fourth when it was approximately one inch in diameter.

TABLE I.—SHOWING RESULTS OF SPRAYING FOR PEACH FRUIT SPOT IN 1907.

Plot	"A"	"B"	"C"	"D"	"E"
1	.....	.....	.....	.....	99
2	.....	.....	.....	.....	99
3	L. S.	.....	.....	.....	100
4	L. S.	.....	.....	.....	100
5	L. S.	Bord.	.....	.....	95.4
6	L. S.	Bord.	.....	.....	95.4
7	L. S.	Bord.	Bord.	.....	89.3
8	L. S.	Bord.	Bord.	Bord.	56.4
9	Bord.	Bord.	Bord.	Bord.	28.3
10	Bord.	Bord.	Bord.	.....	75.9
11	Bord.	Bord.	.....	.....	96
12	Bord.	Bord.	.....	.....	96
13	Bord.	.....	.....	.....	99

A glance at this table leads to the conclusion that the results of the season's work were far from satisfactory. This is not true. Upon visiting the orchard shortly before the fruit

Fig. III. Fruit from Sprayed Tree. Only One Small Basket Infected.
Fig. IV. Fruit from Unsprayed Tree. But Two Baskets of Clean Fruit.

Figs. V. and VI. The Sprayed Portion of the Orchard Produced a Fair Crop (1907).

was to be gathered and making a critical examination of the various plots, we were much impressed with the very marked differences in the fruit on the sprayed and unsprayed trees. The fruit upon those trees which had received all four applications appeared to be almost absolutely free from spots, while all of that upon the unsprayed trees was more or less infested and much of it was worthless. Moreover, the foliage of the sprayed trees was in much better condition and the trees were evidently more vigorous. The results were so marked that casual visitors to the orchard noted them and inquired the cause. The discrepancy between these observations and the final results as exhibited in the above table is explained by the fact that in estimating the percentage of infested fruit, only two grades were considered, viz: "clean" fruit and "infested" fruit. A single spot upon a peach, while it would scarcely impair its market value, was sufficient to class it with the culls. Therefore, while much of the infested fruit from the unsprayed trees was practically worthless (Fig. 1), nearly all of the so-called culls from the trees which had received the four applications could have been marketed as second, and much of it as first grade fruit (Fig. 2). Had the fruit been sorted into commercial grades instead of into "clean" and "infested" fruit, the results as tabulated would have been much more favorable for the sprayed trees.

Moreover, the facts gleaned from the above table became important when we came to plan the work for 1908.

The results obtained upon plots 3, 4 and 13 indicate very clearly, that so far as controlling peach fruit spot is concerned an application of lime-sulphur solution or of Bordeaux mixture before the buds open is worthless. Reference to plots

5, 6, 11 and 12, shows that the second application, likewise, was of very little value; and since we may assume that the spray applied at this time would remain efficient for at least ten days, we are led to the conclusion that infestation of the fruit probably did not begin much before May 10. We may also reasonably conclude, from the fact that practically all of the spots upon the fruit which had been sprayed four times were very small, that the protective influence of the last spray did not extend quite to the end of the period of infestation, and this conclusion is supported by the fact that light showers which would provide conditions favorable for infestation occurred as late as June 22.

From the single season's work, then, we may conclude (1) that peach fruit spot can be controlled by spraying; (2) that so far as this disease is concerned the first and second applications were worthless; (3) that practically all of the infestation of the fruit occurred between May 10 and June 15; (4) that during that period the fruit should be protected by some fungicide; (5) Bordeaux mixture (3-6-50) was the only spray used upon the trees in foliage. There is some danger of injuring the foliage with Bordeaux, but under the conditions which prevailed during our experiments none whatever occurred.

Work in 1908.

November 1, 2, 1907, the entire orchard was sprayed, with the exception of one row through the center, which was left as a check. All of the trees south of this row were sprayed with "stock solution" lime-sulphur (sp. gr. 1.255, Beaume 29.5) diluted 1 to 9; all north of the row were sprayed with 6-6-50 Bordeaux. About one-half the leaves had fallen before the applications were made.

Notwithstanding the fact that the results of 1907 demonstrate that the first and second applications were valueless, it was thought best to test this conclusion by another season's work, hence the plan of work for 1908 was essentially the same as for 1907, except that the entire orchard was sprayed and the various sprayings were so timed that the fourth occurred June 24 instead of June 1. Provision was also made for a larger number of plats for testing a somewhat greater range of combinations as shown in the following table. Stock solution lime-sulphur was also used upon some of the plots after the trees were in foliage.

In the table the various columns correspond to those of Table I except that the one marked "Fall" shows the spray which was applied November 1, 2, 1907. The dates of the other applications were as follows:

"A" represents first spray applied March 4-5 just as the buds were beginning to swell.

"B" represents second spray applied May 13.

"C" represents third spray applied June 4.

"D" represents fourth spray applied June 24.

"E" represents per cent of infested fruit at picking time.

TABLE II.—SHOWING RESULTS OF SPRAYING FOR PEACH FRUIT SPOT IN 1908.

Plot	Fall	"A"	"B"	"C"	"D"	"E"
1	.....	.....	.....	.....	.....	83.8
2	.....	.....	.....	.....	.....	65.8
3	Bord.	.....	.....	.....	.....	46.6
4	Bord.	Bord.	Bord.	Bord.	.....	2.7
5	Bord.	Bord.	Bord.	Bord.	Bord.	3.6
6	Bord.	.....	.....	Bord.	.....	39.2
7	Bord.	.....	.....	Bord.	.....	30.3
8	Bord.	.....	.....	.....	Bord.	41
9	Bord.	Bord.	.....	.....	Bord.	21.5
10	Bord.	.....	Bord.	.....	.....	8.4
11	Bord.	Bord.	.....	Bord.	.....	25.6
12	Bord.	Bord.	.....	.....	.....	41.2
13	Bord.	.....	Bord.	Bord.	.....	4.1
14	Bord.	Bord.	.....	.....	Bord.	21.5
15	Bord.	.....	.....	.....	Bord.	41.4
16	.....	Bord.	.....	.....	Bord.	78.1
17	.....	.....	.....	Bord.	Bord.	76.3
18	.....	.....	Bord.	Bord.	.....	36
19	Bord.	.....	.....	L. S.	.....	30.2
20	Bord.	Bord.	.....	L. S.	.....	19.6
21	L. S.	.....	L. S.	L. S.	L. S.	15.8
22	L. S.	L. S.	Bord.	Bord.	.....	3.9
23	L. S.	L. S.	Bord.	Bord.	.....	17.1
24	L. S.	L. S.	Bord.	Bord.	Bord.	2.5
25	.....	L. S.	.....	Bord.	Bord.	50.9
26	L. S.	.....	L. S.	L. S.	.....	9.7
27	L. S.	L. S.	L. S.	L. S.	.....	8.8
28	.....	L. S.	L. S.	.....	.....	21.7
29	.....	L. S.	.....	Bord.	.....	50.8
30	L. S.	.....	L. S.	L. S.	.....	19.4
31	.....	.....	L. S.	L. S.	.....	34
32	.....	.....	.....	L. S.	.....	64.3
33	Bord.	Bord.	L. S.	L. S.	L. S.	10.7
34	Bord.	Bord.	.....	.....	L. S.	10.5
35	Bord.	.....	.....	L. S.	.....	25

The stock solution lime-sulphur which was used in 1908 had a specific gravity of 1.25 (Beaume 29). For the first application it was diluted 1 to 10; for the second, 1 to 18, and for the third and fourth, 1 to 20. Bordeaux 5-6-50 was used for the first spraying and 3-6-50 for the second, third and fourth.

Bordeaux again caused no injury whatever to the foliage. The lime-sulphur, 1 to 18, which was used for the second application, caused an almost perceptible amount of injury; but when the effect of the third application, 1 to 20, was added to this the injury became quite noticeable. For this reason only a comparatively few of the trees were sprayed for the fourth time with lime-sulphur, but on these no further injury could be detected.

Figs. VII. and VIII. Showing Effect of Fall Spraying in Controlling Peach Twig Blight.

In the main, the conclusions, which were drawn from the results obtained in 1907, are sustained by those of 1908. Again does it appear that the first applications, just as the buds are swelling, is of practically no value in controlling peach fruit spot. Again are we led, by the good results obtained from the second and third applications, which correspond very closely, in dates, to the third and fourth applications of 1907, to the conclusion that the period of infestation by the fungus is confined from May 10 to June 15 and that this, therefore, is the critical period during which the growing fruit should be thoroughly protected by spraying. However, the inference that good results would follow an additional application in late June was not justified by the results. Moreover, at picking time, much of the fruit which received the last spraying

(Continued on page 833.)

Reclamation Notes

CALIFORNIA.

Sacramento, California papers state that one of the greatest enterprises in irrigation is the increasing of the acreage in the Trucke-Carson project from 20,000 to 206,000 at a cost of $3,000,000, of which $1,250,000 will be spent on a dam. It is planned to have 300 or 400 men employed on the project for two or three years.

Work has been started on the reclamation of several thousand acres of Tule land along the line of the Southern Pacific Railway between Suisun and Benicia. The land is owned by capitalists of San Francisco.

President Taft recently signed what is known as the Chuckawalla Irrigation Bill, which gives the Chuckawalla Development Company a concession to dam the Colorado River above Parker. This large project, which will be carried on in the eastern part of Riverside county, is very important to people of that vicinity.

The directors of the Hallwood Irrigation Company held a meeting at Marysville recently. It was expected to have the canal completed within three months' time and that 5,000 acres, possibly a larger area, will be irrigated the first year. This district lies only a few miles east of Marysville.

The California Development Board has submitted a bill which is now before the state legislature, calling for the establishment of four or more demonstration farms to be conducted in regions of the state which are not likely to be brought under irrigation in the near future. Not more than one of these farms is to be located in one county. The bill asks for an appropriation of $15,000 for the equipment and maintenance of these farms the first year and $7,500 the second year.

The Sacramento Valley Irrigation Company, which owns 15,000 acres of land adjacent to Hamilton City, has recently acquired a half interest in the Hamilton Beet & Sugar Company's plant and announce that they intend to commence extensive improvements in their business.

A flow of water sufficient for irrigating adjacent lands has been struck in several wells in the Richgrove district, a tract of 3,000 acres recently put on the market by the Ensign-Francis Company of Los Angeles. Richgrove is located in the heart of the early orange belt of Tulare county.

COLORADO.

The Orchard Mesa irrigation system is completed. February 21st the Orchard Construction Company, through Messrs. G. J. and C. C. Magenheimer, turned over its final check to Contractor J. J. Lumsden and this incident marked the close of the work on the big system.

Without a dissenting vote, the landowners in the Henrylin irrigation district have let the contract for the building of ditches and reservoirs. The district lies in the vicinity of Hudson.

The contract provides for a system to cost $4,300,000 and includes the construction of the mountain tunnel to bring the water of the Williams Fork of the Grand river into Clear creek and from there into the Platte river.

An irrigation project which will cost $3,000,000 to $5,000,000 will be started within a short time on land adjoining Pueblo on the north and east. The new company will be known as the Pueblo, Fountain, Chino & Squirrel Creek Irrigation Company. Articles of Incorporation have been filed. The company will secure water from the Chino and Squirrel creeks, and these reservoirs will contain more than 2,000,000 acre-feet when filled.

Contracts have been signed which assure the immediate commencement of work on the Stanley Lake irrigation project north of Denver.

The jury in the case of J. A. Hughes vs. the Twin Lakes Water Company returned a verdict awarding damages of $1,500 in favor of Mr. Hughes, who sued for $2,450 damages, which he claims was caused to growing crops on his farm near Boone by overflow water from the company's ditches.

C. T. Pease, project engineer of the Gunnison tunnel, announces that work is to begin immediately upon the new canal, which will be taken from the south canal and conveyed along the side of the Uncompahgre valley as far as Delta, to water a large amount of water above the present irrigation system. This is made possible by the recent appropriation of $1,500,000 for the Gunnison project.

The question of forming an irrigation ditch covering over 300,000 acres of rich land in Otero, Bent and Kiowa counties, will be submitted to a vote of the resident freeholders early in May, petition for the same having been filed with the county commissioners.

The recent validation in the district court of the $3,000,000 bond issue of the Mammoth irrigation district marks the beginning in earnest of a project which contemplates the reclamation of about 80,000 acres of as fine land as can be found in either Prowers or Kiowa county and lying directly tributary to Lamar. The Mammoth irrigation district was opened less than a year ago and has made rapid progress.

Plans for the reclamation of 36,000 acres near Trinidad are reported with the filings of maps and plans of the Tyrone reservoir, Inlet and Outlet ditches. The project is backed by O. C. Norton and C. L. Colburn of Denver and the estimated cost of the reservoir and ditches is $240,000. The reservoir is to be thirty-five miles northeast of Trinidad.

The Terrace irrigation district, newly formed, has purchased the holdings of the San Luis Land & Irrigation Company of Colorado Springs for $300,000 and will complete the immense reservoir. The district embraces 34,000 acres, to be watered frfom the reservoir.

That Bent county is making good on its claim of being the center of the district, having now in progress or course of construction the greatest number of substantial irrigation projects of any section of the state, is evident from present activity.

OREGON.

During a conference with Representative Hawley, of Oregon, and Frank Ira White, representing the Klamath Chamber of Commerce, Secretary Ballinger stated recently that the government would proceed with the construction of the Klamath irrigation project and carry it to completion.

The Secretary explained that the apportionment of the reclamation fund as recommended by the army board of engineers cannot stand, but that fund must be used as needed.

The government irrigation scheme devised by Captain O. C. Applegate in Klamath County promises to reclaim 10,000 acres of land to agriculture, and make the Indians on the Klamath reservation self-supporting. If this promise is fulfilled one government irrigation project will go on record as having made valuable returns on the investment.

Recent dispatches from Washington state that the Senate has agreed to an amendment to the Indian bill, appropriating $50,000 to resume work on the Modoc Point irrigation project on the Klamath Indian Reservation.

Josephine County has become an alluring field for irrigation companies that desire to install a general system of canals and ditches. About two years ago the

Golden Drift Mining Company, owning a dam across Rogue River, about three miles east of Grant's Pass, was in position to furnish water. In order to further promote the general interest, farmers and fruit growers in that vicinity organized the Josephine County Power & Irrigation Company. This local organization entered into a contract with the Golden Drift Mining Company whereby the dam, water rights, machinery and pumping plant were to be absorbed by the purchasers. Under [illegible] the Josephine County Irrigation and Power Company built twelve miles of ditches and expended [illegible] money in development work, which re[illegible]igation for a large territory. The company [illegible] directors H. L. Gilkey, H. C. Kinney, [illegible] H. Carner, E. E. Blanchard, O. S. Blanch[illegible] and J. E. Hair.

[illegible] of the Chicago Rogue River Company [illegible] Josephine Irrigation Company and its ditches [illegible] was not received favorably. The tentative [illegible],000.

The Central Oregon Irrigation Company, successors to the Deschutes Irrigation and Power, will throw open for settlement between 5,000 and 6,000 acres of land adjacent to Prineville. The tract now being placed on sale for the first time contains some of the finest land in the entire segregation, lying between Prineville and Powell Butte, and is a part of the Butte segregation. This is the first opportunity that Prineville people have had to secure Carey act lands close to town, and no doubt many will take advantage of the last chance to get an irrigated ranch in the present segregation.

The lands under the Benham Falls project will be the next to be put on the market at a cost of $60 per acre to the settler instead of $40 per acre, the price of land under the present segregation.

E. J. Sommerville, of Pendleton, was recently appointed by Circuit Judge G. W. Phelps as receiver of properties of the Inland Irrigation Company in possession of Henry W. Coe, his companies and sub-agents.

A local syndicate composed of some of the members of the Ontario Land and Townsite Company closed a deal recently for all of the holdings of the Willamette and Cascade Military Road lands. These lands surround Ontario on the north, south and west, and much of it is located within one mile of the business center and practically all of it is within two miles of the city. The new owners are already at work with a force of engineers in platting the land in acre tracts, and will install an irrigation plant that will water every acre. This plant will be located three miles south of Ontario on Snake River, from whence a pipe line 10,000 feet long will take the water to the high bench adjoining Ontario.

The Secretary of the Interior has approved the plans of the farmers living in the valley between Lost River and Stukel Mountain, twelve miles south of Klamath Falls. Water will be taken out of Lost river above a dam which is to be bulit by the reclamation service, and which will raise the water high enough so that it can be taken over a small ridge, which, without this, would have been impossible without raising the water with a wheel or some other force. About 1,500 acres of land are embraced in the valley.

An irrigation system which will reclaim 40,000 acres of land in Josephine county in the north end of the Rogue River Valley, including the Merlin and Grants Pass districts, is practically assured. Porter-Fishback & Co., one of the strongest bond houses in the country, has agreed to finance the project on two conditions—that a clear abstract to the land and rights to the water can be shown. Edmund T. Perkins, who has recently resigned from the service of the government, has been engaged to make the investigations. As soon as the report on the project has been verified by Mr. Perkins for Porter-Fishback & Co.. the Rogue River Valley Power & Irrigation Company will begin the construction of an enormous impact dam at Savage Rapids, seven miles from the city of Portland, as well as one at Hell Gate. fourteen miles below Portland. From these two dams it is believed that 15,000 horsepower can be secured.

Notice has been received at the Federal Land Office at Lakeview of the restoration to settlement and entry from the Silver Lake Irrigation project in Lake county, of all of sections 15, 20 to 28, 33 to 36, township 28 south, range 15 east; sections 19, 20 and 29 to 33, inclusive, township 28 south, range 16 east; sections 1, 2, 3 and 10 to 14, inclusive, township 29 south, range 15 east; sections 4 to 9, inclusive, 16, 17 and 18, township 29 south, range 16 east, Willamette meridian. This land will become subject to settlement on and after November 26th, but filings will not be accepted by the Lakeview office prior to December 26, 1910. The land involved is situated about 10 miles northwest of Summer Lake and comprises 10,000 acres.

The stockholders of the Anna River Irrigation Company of Lakeview have made plans to install a pumping plant sufficiently large to irrigate 2,500 acres of land, and the work will be begun at once. The estimated cost is $3,000. A 14-foot dam has already been constructed and by placing the power plant a short distance below the dam sufficient power can be obtained to raise the water 40 feet, which will be sufficient to cover the land to be irrigated.

The Warner Valley Land and Irrigation Company of Lakeview, through the state engineer, has applied for the segregation of 150,000 acres of land, a part of which the company caused to be withdrawn from entry under the Carey Act a year ago. The company has a watershed of 800 square miles, and plans to take water from a reservoir to be built at a point where Honey Creek leaves the hills of the Warner mountains and flows to the Warner chain of lakes. The plans of the company also cover the pumping of water from Warner lake by electricity supplied from power afforded by Honey and Deep creeks, where immense storage and power reservoirs will be built.

The Central Oregon Irrigation Company of Portland has filed articles of incorporation, with a capital stock of $1,000,000, and will take over the work of the Deschutes Power and Irrigation Company. In the articles of incorporation it is shown that the company intends to develop the Pilot Butte, Central Oregon, Benham Falls and North Canals.

At a meeting of ranchmen at Vale on October 25th, it was estimated that from the money now in sight on the Malheur project 45,000 acres of land can be covered in the undertaking. The ranchers all expressed a readiness to sign the agreements. The estimated cost of the project is $1,000,000. The reservoir site is at Warm Springs, near Riverside division dam in the canyon.

The farmers of Burnt River Valley held a meeting at Unity in October and discussed the development of an extensive irrigation project for the valley. The plan as proposed is to bond the land to be watered to raise funds to build dams and reservoirs and make other improvements. It is estimated that $100,000 will be ample to complete the work.

Extensive revision of the Oregon irrigation code is provided in a bill introduced by representative Brooks at Salem. The proposed amendments, if adopted, embody the best features of the irrigation laws of the states of Wyoming, Colorado, California and Idaho, and will assist irrigation enterprises in these states. Principal among the changes is one enlarging the powers of the board of directors of irrigation associations, thus enabling them to treat with all complications arising.

C. W. Fulton of Portland has filed a protest against the legality of the Klamath Lake reclamation project in the federal court. He represents interests opposed to the closing of navigation on Klamath Lake for the purpose of completing the government's $3,000,000 irrigation project. Mr. Fulton stated in a recent interview that it was necessary for him to attack the whole project in order to gain the point desired by his clients. He also asserts that the act by which the shore line of Klamath Lake was ceded to the United States was illegal in that the United States cannot obtain title to lands in such manner.

NEW MEXICO.

The Las Vegas grant board has signed a contract under which the Camfield project is to be finished by December 1, 1911, and under which water will be impounded in July, 1911. The completion of this project will ultimately bring 17,000 acres of land under irrigation.

The Canadian Valley Irrigation District Board was organized at Logan on October 22d. C. W. Abernathy was elected president and E. L. Merrill, secretary.

The farmers on the tract of the French Land and Irrigation Company, near French, are considering the advisability of forming an independent irrigation company.

Harry Kinsell and James Reaves, of Stanley, have filed a water right on the flood waters east of Stanley, and will start work on the Stanley irrigation project about the first of the year.

It is reported that a big combination of city power plants, having for its object the supply of water for irrigating New Mexico lands, is being attempted by interests representing John D. Rockefeller. It is reported that the Albuquerque Light and Power Company, one of the largest in the country, has already been sold to these interests.

Incorporation papers have been filed in the office of Territorial Secretary Nathan Jaffa by the Farmington Power and Irrigation Company, of Farmington. The capitalization is $100,000, divided into 1,000 shares.

A contract for $480,000 has been awarded by the Orchard and Irrigation District to the Standard Construction Company for the irrigation of 12,000 acres of Mesa land lying north of Farmington, New Mexico. This project has been under way for several years and the many claimholders, as well as the owners of deeded lands under the survey, have worked to bring new life into the project and feel now that they are in a fair way to reap the reward of patience and diligence.

Dispatches from Santa Fe state that the fate of six large irrigation enterprises, involving the expenditure of $10,000,000 or more, depends upon the outcome of the hearing of six appeals before the Territorial Board of Water Commissions, begun recently in that city. These projects, the applications for which were rejected by the territorial engineer on account of the stand taken by the reclamation service, which claims all of the waters of the Pecos for the Carlsbad Irrigation Project in Eddy county, are those of Lake Urton of the Ft. Sumner and Pecos Land Company, H. B. Jones, A. A. Jones and others. The contention of the reclamation service is the same as in the case of the Rio Grande, where an embargo has been placed on all unappropriated waters of the river and its tributaries because of the Engle dam.

Articles of incorporation have been filed in New Mexico by the Chama Valley Lands & Irrigation Company of Kansas City, Mo., which has a capitalization of $100,000. Among the incorporators are Albert D. Hart, R. E. Auchmoody and William Kent. O. O. Car of Chama is named as statutory agent.

MONTANA.

The date of October 22d, which was scheduled for the opening for settlement the Carey Act project on the Dearborn river, was cancelled by the State Carey Board, which holds that the work of reclamation is progressing so slowly that the Great Falls Land and Irrigation Company will be unable to furnish water to settlers on June 1, 1911, as agreed. They will, therefore, not permit the land to be sold until satisfied as to the time when the water will be available.

The McKeller Creek Reservoir Company, composed of ranchmen whose land is tributary to McKeller Creek on the west side, has filed articles of incorporation, with principal office at Stevensville. It is the purpose of the company to dam two small lakes at the foot of St. Mary's peak, which is the head of McKeller Creek, and also to dam McKeller Creek and use the water for irrigation during the summer months.

The Billings Land and Irrigation Company of Billings has commenced action in the district court, seeking to secure a right of way for a ditch through the land owned by John H. Dover, situated between Huntley and Billings.

The hearing of a petition for an irrigation [illegible]trict on Blodgett Creek, near Hamilton, was heard by [illegible] T. Meyers in the district court on October 18th. [illegible] tion was granted and the boundaries fixed. [illegible] will include 1,400 acres of land. Dams and re[illegible] be built for the purpose of impounding the [illegible] of the creek, so that they may be used later f[illegible] purposes.

MISCELLANEOUS.

The state engineer of Wyoming has approved the water right and the state land board has approved the segregation of lands for the project of the Riverside Irrigation Company, which will reclaim 150,000 acres of land near Shoshoni. The company will install a pumping plant in the Big Horn river, 18 miles above Boysen, Wyoming, from which place it will obtain its electric power. The main canal will be 20 miles long. The main ditch passes close to the town of Shoshoni, Wyoming.

A project involving 75,000 acres of land in the vicinity of Douglas, Wyoming, is being undertaken by the North Platte Valley Irrigation Company. The tract is divided into two sections, one embracing 25,000 acres which will be irrigated by pumping, and the other 75,000 acres to be watered by the gravity system. Work on the pumping system, which will be installed at a cost of approximately $500,000, has been begun. The generating equipment, water wheels, of the turbine type, and the pumps will create 300 horsepower, and the current will be transmitted twenty miles to the pumping stations, two in number, where the high voltage will be stepped down so as to serve the five three horsepower pumps in one and the two pumps of the same capacity in the other station.

Experiments made with the black, waxy land of Bell county, Texas, to ascertain its adaptability to irrigation, have proven successful and demonstrate the wonderful producing capacity of the land under such conditions.

The Pecos & Joyah Lake Irrigation Company of Pecos has filed its charter with the secretary of state, with a capital stock of $1,500,000. About 22,000 acres of land will be irrigated by this company.

A company known as the Pacific Reclamation Company of Elko, Nevada, proposes to open for settlement in Elko county 35,000 acres of land. This land will be irrigated by water taken from Bishop creek, and other creeks in the mountains, and the company has asked for bids for the building of dams, reservoirs and canals. The company has taken up 10,000 acres under the Carey Act, has purchased 15,000 acres from the Southern Pacific and 10,000 acres from M. Badt of Wells.

A Louisiana land project has been financed by La Crosse, Wisconsin, men and articles of incorporation have been filed at Madison, Wisconsin. The company is known as the Southern Delta Land Company and is capitalized at $150,000.

The San Benito Land Company of San Benito, Texas, has purchased from C. P. Barreda 5,000 acres of land located east of the Sugarlands, making in all 50,000 acres which will be under the irrigation system of the San Benito Land & Water Company. The canals will be extended to the new addition at a cost approximating $100,000.

The dedication of the Roosevelt Dam in Arizona will take place March 18. The last stone was set in the walls on February 5. From the foundation to the parapet of

the dam is 284 feet. It has a length of 1,080 feet, the top being covered by a 20-foot roadway. This dam will hold water to irrigate approximately 200,000 acres of land near Phoenix.

The Reclamation Service has ordered about 2,000 feet of motion pictures of the Royal Gorge and many other scenic features adjacent to Canyon City, Colo., which are to be used in advertising the irrigation projects of the west. The Denver & Rio Grande is to use the same films in connection with others which they have had made.

Preparatory work on the extension of the Truckee-Carson irrigation project began recently near Hazen, Nev. The work will be carried on under the direction of Superintendent Tillinghast.

The Belle Fourche Dam, near the city of that name in South Dakota, said to be the largest earth embankment in the country, if not in the world, is nearing completion. Construction of this project was authorized by Congress in May, 1904. The total cost, which will be considerably in excess of the original estimate, will run something over $5,000,000. From an engineering standpoint, this project is one of much interest. The principal structure is the earth dam, which is something over 6,200 feet long.

Senate Bill No. 181, introduced by Senator Wilson of Utah, will, if it passes, authorize the State Board of Land Commissioners to loan money on irrigation projects. This bill is likely to go through as it is recommended for passage by the committee on ways and means.

In recent information from Plainview, Texas, we learn that a representative of the Westinghouse Company, who spent several days in that city investigating the water and irrigation possibilities of the section, announced that it was practically settled that the company would put in a power plant for the purpose of furnishing power for irrigation projects.

Plainview, Texas, has the distinction of being the first town, to our knowledge, to hold a water show and irrigation conference. Just what the title of this organization indicates is difficult to say.

The Senate Committee of Texas on Mining and Irrigation reported favorably on the Chapin Irrigation Bill, but it is understood that there will be much opposition to this bill in the House and Senate. The bill, as stated by one of our correspondents, deprives riparian owners of their rights by the provisions for condemnation, but voters without any just claim to water can vote bonds and a tax for irrigating lands that ought not to be watered. One gentleman who spoke on the bill said that its passage would hurt the development of the Rio Grande Valley, in that it would place a cloud on the securities of irrigation companies, as it gives commissioners of a district authority to condemn a canal without a vote. Where such a condition exists, so the speaker stated, it would be impossible to get money for canal purposes, as no one would wish to take canal property for security where it could be condemned indiscriminately.

The Glazed Cement Pipe Company will this week commence a 25 carload shipment of pipe to Opportunity, east of Spokane, where the pipe will be used in the development of an irrigation project in Pierce's Orchards. The purchase of the cement pipe is in keeping with the orchard company's policy to install one of the most perfect systems in the northwest, with complete pumping station equipment and concreted wells being important features in the permanent improvements.

A bill authorizing the Secretary of the Interior to sell water from irrigation projects to private concerns was again passed by the House late in February when the conference report was adopted containing senate amendments. The bill gives the Secretary permission to sell surplus waters from government irrigation projects when the demands of the projects have been fully satisfied. The water thus sold must be used solely for distribution to

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To find the side BC by trigonometry proceed as follows: $BC/AB = \sin \alpha$ then $BC = AB \sin \alpha$; look up the sine of $\alpha = 45° 37' = .71488$; then, $BC = 17 \times .71433 = 12.153$ ft.

Problem 2. The side $AB = 14.73$ ft. and angle $\alpha = 23° 16'$; find AC and BC.

Solution. Since $\alpha = 23° 16'$, then $\beta = 90 - 23° 16' = 66° 44'$; also: $AC/14.73 = \cos 23° 16' = .91868$; hence: $AC = 14.73 \times .91868 = 13.532$ ft.; $BC/14.73 = \sin 23° 16' = .39501$; hence: $BC = 14.73 \times 39501 = 5.8185$.

Problem 3. Let $AC = 13$ ft. and BC 20 ft., find the other part of the triangle.

Solution. $\operatorname{tg} \alpha = BC/AC = 20/13 = 1.53846$, look in a table of natural tangents and find that 1.53888 corresponds to 56° 59′ and 1.53791 corresponds to 56° 58′, so the value of the angle α lies between 56° 58′ and 56° 59′, a little nearer to 56° 59′, which will be taken for the answer.

Angle $\beta = 90° - 56° 59' = 33° 1'$.

The side AB is found as follows:

$BC/AB = \sin \alpha$;

$AB = BC/\sin \alpha$

Substitute the values for $BC = 20$ and $\sin 56° 59' = .8385$; then $AB = 20 \div .8385 =$

$AB = 23.851$ ft.

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still bore more or less of the spray deposits, which were difficult to remove, without injuring the delicate bloom.

Perhaps the most important result of the season's work was to demonstrate the value of fall spraying for this disease. Every plot which received this application gives evidence of its value and every one of the plots which gave the best results, viz: 4, 5, 10, 13, 22, 24, 26, 27, 33 and 34, were fall sprayed either with Bordeaux or lime-sulphur.

Little can be said as a result of the season's work as to the comparative value of Bordeaux mixture and lime-sulphur solution for spraying peaches. The Bordeaux seems to have given slightly better results, but the difference is so slight as to be easily within the range of error or normal variation.

It is usually considered a dangerous practice to use Bordeaux mixture upon peach trees in foliage, but under the conditions which have prevailed at Ashland during the past two seasons no injury whatever has resulted from the use of the 3-6-50 formula. This does not argue that injury might not occur under less favorable conditions and growers who plan to use Bordeaux upon their peach trees are urged to exercise care in the preparation of the mixture and also, if possible, to avoid spraying in cold, rainy weather. The more vigorously the trees are growing the less susceptible will they be to the Bordeaux injury.

We have conclusively demonstrated during the past three years that lime-sulphur gives better results than does Bordeaux in preventing apple scab, and that by its use the danger of spray injury may be eliminated. It was hoped that similar results might follow its use upon the peach. Eventually such may be the case, but from the single season's work all that can safely be said is that in all probability stock solutions which test 30 degrees Beaume, if diluted 1 to 30 or 35, would not injure foliage and would probably be efficient in checking the disease.

In this connection the attention of growers is called to the following statement of Mr. W. M. Scott, of the U. S. Department of Agriculture, that "The self-boiled lime-sulphur mixture, however, when prepared as a mechanical mixture of lime and sulphur with only a small percentage of the sulphur in solution, is not injurious to peach foliage; and in our experiments for two years past has proved to be a good fungicide."

Peach fruit spot probably causes a loss to the peach and apricot growers of Oregon greater than that caused by all other peach diseases.

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individuals. The money realized from such sales is to go into the general reclamation fund.

An order has been issued from the Department of the Interior regarding the payments for lands under the Belle Fourche Irrigation project. Public notices heretofore issued in pursuance of the Reclamation Act of June 17, 1902, announcing the charges for land opened under the Belle Fourche project, South Dakota, are suspended as to the charges, times and manner of payment, for lands as follows: Lands hereafter entered; lands in private ownership, not now held under trust deed; and lands not now signed under contract with the Belle Fourche Valley Water Users' Association.

Applications for water rights for such lands may be made and received subject to such charges, time and manner of payment as may be fixed by public notices hereafter issued.

Steps were taken in Portland, Ore., recently, to organize an apple-selling agency, representing all of the apple districts of the Pacific Northwest, the idea being to control practically the entire boxed apple output of that

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TREATING RUBBER.

Visitors to the extensive plant of the Goodyear Tire & Rubber Company at Akron, Ohio, if they become interested enough to watch the progresses through which the crude rubber is put, will be surprised at the apparent life in it, both before and after spending a month in the drying chambers.

Anyone watching a huge mass of crude rubber that has been thrown into one of the great "cracking" machines, will become impressed with a sense that it is not inanimate. To strangers in the factory there comes a hazy idea that the mass is not devoid of life, which superinduces a somewhat creepy feeling as the dark-looking thing squirms and twists in the grip of the machine and squeals and emits little shrieks, as if it were being tortured.

The mass of crude rubber is named variously according to the part of the world from which it was imported. It comes from the region of the Amazon in South America in what are termed "hams." But it is a "masai" of rubber if it comes from Sierra Leone.

After the crude mass has been "cracked" and washed it is sent up to the drying chambers, where it is allowed to rest for a month.

"That gives it time to recover its original strength and resiliency," explains P. W. Litchfield, superintendent of the Goodyear Tire & Rubber Company, who has studied with interest the peculiarities of crude rubber. "Everything we do to it seems to rob it of some of its life and strength, but it always recovers if given time. Operators say the same of steel that it loses some of its life from too much handling, but recovers if allowed a few days of rest."

After its month of rest in the drying chamber the crude rubber is milled or broken down between two large rollers, with which it fights like a creature of life, snapping and crackling in noisy protest. It comes off these rollers in strips about twenty inches wide and perhaps a quarter of an inch in thickness. In that form it is rolled up neatly and is allowed to lie for four days while recovering the strength and resiliency.

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St. Mary-of-the-Woods, St. Marys, Vigo County, Indiana.

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country. The organization was not completed but the preliminaries were accomplished. The meeting adjourned to meet in Walla Walla, Wash., February 28.

The result of the meeting at Walla Walla is not known to us at this writing. If this is organized along the line of the union of citrus fruit growers on the Pacific Coast, it will result in good for all interested.

Mr. James T. Donahoo, who expects to bring about irrigation by water from the underflow of the Arkansas river, has recently been talking to the people of Hutchinson, Kan., about his plan.

Mr. Donahoo is a former citizen of Sidney, Neb., and Hutchinson papers state that he is the originator and patentee of a system of underflow irrigation which will materially change things.

This is the first time that we have known of any patent appliance being issued to lift water from the underflow other than by pumping.

Mr. Donahoo's plan is to put down a row of pipes about 40 feet deep and only a few inches apart. These are to be cut off and connect with lateral tilings. The underflow entering the pipes through the perforations will seek its level and run up into the tile which will carry it into a ditch without any pumping being required.

Mr. Donahoo states that he can lift every foot of water in the underflow to the surface by artesian force, which will give a perpetual supply and the only cost is the first cost of installation. It is said that the gentleman is putting down test holes near Garden City for purposes of demonstration.

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used. Eighteen to twenty pounds of good seed is the usual amount of seed used when sown broadcast. Twelve of fifteen pounds of seed will be sufficient if sown with a drill. There are various makes of cheap hand seeders on the market which are very practical for sowing the seed broadcast. The seed may be sown with a common grain drill with the discs set to sow as shallow as possible. When a grain drill is used the seed may be mixed with ground meal using one-third of seed to two-thirds of the meal or ground barley; then sowing the resultant mixture at the rate of three and a half to four and one-half pecks per acre. Should sufficient moisture not be present in the soil for rapid germination of the seed, it is best to defer planting to a more favorable time, or if need be, until next season.

The first year is largely spent by the alfalfa crop in establishing the plants in the soil and full crops are not secured until the second or third season. During the first season it is advisable to mow the alfalfa once or twice, with the sickle bar of the mower run high, in order to keep down weeds and prevent them from going to seed. Young plants must not be cut too late in the fall of the first year, for if allowed to form at least five or six leaves before cold weather sets in they will withstand the rigors of winter much better.

If the weather conditions in the spring are especially favorable and plenty of moisture is present, a good stand of alfalfa may be secured on land that grew a cereal crop the previous season, but as the cost of seed is great it will not usually pay to take the risk. In this case it will be best to early fall plow the stubble land, sub-surface pack in the spring, thoroughly harrow then use a planker or a tilting drag run flat to improve the physical condition of the soil before sowing the seed. Alfalfa should not be sown with a nurse crop as all the moisture and sunshine is needed by the young plant.

When manure is applied to the land, it may not be necessary to resort to artificial inoculation of the soil, which in the major portion of the state appears necessary in order to obtain healthy growth of the alfalfa. Excellent results have been obtained at the Edgeley Station by inoculating the land with soil taken from an old alfalfa field where it was known that the bacteria was present in abundance. The soil was sown broadcast by hand at the rate of one, two and three hundred pounds per acre and harrowed at once. This was done at time of sowing the seed. One hundred pounds of dirt per acre gave as good results as a greater amount. If a manure spreader is used in scattering the manure, a small amount of the dirt may be sprinkled over each load before it is hauled to the field thereby saving additional labor in scattering.

During the first season after the young alfalfa plants have attained a height of three or four inches, it is a good practice to harrow the field in order to loosen up the soil and conserve moisture. As the crop grows older, harrowing and discing may be continued at needed intervals when the soil becomes hard and dry. Discing not only splits the crown of the plant and causes it to branch more freely, but it also stimulates a more vigorous growth.

The best strains of alfalfa are the Grim, northern Montana grown, common, and certain strains of the Turkestan. The seed grown under dry land culture is preferable to that grown under irrigation.

Greater difficulty is experienced in curing alfalfa hay properly than in other grasses. Various methods have been followed in handling the crop and each seem to have their advantages. One of the most popular methods in practice is to commence mowing in the morning as soon as the dew is off, rake into windrows in the afternoon when the hay becomes well wilted, turn the next forenoon after the dew is off and in the afternoon the hay is ready to stack or put in the barn. Should the crop be heavy it is a good plan to pile the hay in small cocks and allow to cure for a few days before stacking or putting it in the mow. A hay tedder and a side delivery rake are excellent tools for handling the alfalfa crop. It is of the greatest importance that dry weather be chosen for curing the alfalfa hay as rain is very injurious to it. The hay should be perfectly free from dew or rain before stacking or placed in the mow.

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a harrow may be used and the leveling process finished with a board leveler, well weighted down. This is nothing more than a strong thick plank weighted with stones and dragged back and forth over the beds until they are in a perfect condition to receive water uniformly upon the surface. The ends of the beds should come up close to the main ditch, or to the large lateral ditch, so that the water can be turned on in full volume. These beds may be irrigated one after the other by flooding, or by furrow irrigation. Indeed, there is no limit to the manner of irrigating, the great desideratum being to spread the water uniformly over the entire bed. It will be perceived that the system is similar to that of the smaller depressed bed-irrigation, except that the ridge ditches are not used, the ridges around the large beds being used to retain the water and to mark out the land in such shape and sized plats as to correspond with the quantity of water on hand. The flow of water must be sufficient so that it will rapidly cover the bed, and if that is deficient then the beds must be made smaller, otherwise the plants at the upper end of the bed will flourish and produce well, whereas those at the lower end will be sickly and produce little if anything. This often happens in the case of corn, potatoes, etc., when the water runs either too rapidly or too slowly into the furrows. The slope of the land should be such as to provide a quick rush of water all along the line, and its standing in the furrows to slowly soak into the soil. For this purpose the source of the water supply must be considerably higher than the land to be irrigated, and the quantity delivered large enough to fill quickly. Too slow a flow and too small a quantity will soak the upper end of the bed and give the lower part too little.

One important thing to be guarded against in laying out the land for irrigation is to avoid the washing out of the soil by the action of the flowing water. Inasmuch as the land irrigated is always under cultivation and loosely put together after the action of the plow, it is very easily washed into gullies, and every gully means a lessening of fertility. There is not so much danger in this respect when the land is covered with a heavy crop and flooded, because then, the plants will retard the rush of water and prevent damage by washing. But in furrow irrigation, the furrow soon may become a deep gully which the plow and cultivator can not remove.

NEW INCORPORATIONS.

Burr Creek Irrigation Company of Montana. Capitalization, $40,000. Incorporators are O. Thomander, J. Sesta, and J. C. Gilman.

The Wheeler Irrigation Company of Oregon. Capital stock, $25,000. Incorporators are J. T. Wheeler, Jr., Thomas S. Farrell, and B. M. Harmer.

Aztec Irrigation Company, Denver, Colo. Capital stock $100,000. Incorporators, Arthur Ponsford and Dr. Roosevelt, of Denver, and W. Goff Black of Aztec, New Mexico.

Narrows Reservoir & Irrigation Co., Greeley, Colo. Capital stock $25,000,000. C. T. Neill, J. T. Warren, S. H. Southard, E. C. Southard, of Greeley; Thomas Grace, James Hurley, P. W. Putnam of Fort Morgan.

Golden Ranch Land Development Company, Lockport, La. Capital stock $1,000,000.

Leon Springs Irrigation Company, Phoenix, Ariz. Capital stock $24,000. J. Y. Webb, Jr., G. A. Beeman and L. B. Milam, all of Dallas, Texas.

(Continued from page 817.)

From a butte above the town, the sight of range on range to the north is a joy to the nature lover. This is a fruit country. Strawberries and big red apples luxuriate in that soil; also cherries and all kinds of berries, nuts, even the English walnut. Wherever there is a margin of soil along the lake, little fruit farms flourish. Out east great crops of wheat are grown. Both east and west of the lake, sheep ranches are numerous and profitable. It is claimed that copper and gold are so abundant as to be, in themselves, a reason why the railroads are bound to come. A few mines are being worked, very profitably; a road, branching off from the lake about half way from Chelan to Stehekin, leads to one important mine.

The winding course of the lake and the variety of formations on either side, give it a constantly changing aspect, so different from most lakes. The water is a deep blue and when one rows about in a skiff, as I did, and remembers that, while he is 1,095 feet above the level of the sea, if he should fall in and sink, he would go down 1,600 feet (at least in some places he would), it is apt to make him somewhat careful with his oars. The lake is not over three miles wide at any point and not often over a mile and a half. Forests rise from the water's edge till they give way to the barren cliffs, whose tops are covered with snows. The rounded walls above the waters show glacial action, though precipitous cliffs, here and there, rise up out of the water to be smoothed off toward the top.

It is not hard to find a good trail up to the top or to some point of observation and see glaciers and snow capped summits in abundance. Up the Stehekin River, which comes from the north into the lake, in two miles we find Rainbow falls, leaping 270 feet over the rocks.

Up to Bridge Creek is fifteen miles, where the Cascades are at your service for sightseeing. All around the lake and the canyon running on to the north of the lake, ribbon like streams, from melting snows, come flowing, down from the serrated peaks and over frowning precipices, to lend a decorative touch to nature's marvelous handiwork.

But scenery is not the only thing to be found. Rev. Dr. Crandall, of Minneapolis, distinguished as a "fisher of men" and scarcely less distinguished as an expert trout fisherman, was in there on his annual pursuit of piscatorial pleasures, and he found it was only necessary to "drop a line" to his finny friends and they would promptly accept his invitation to come up to six o'clock dinner with him. And the air of the lake is sweet, like nectar. The white plague would have a hard time getting a foothold there. Only here and there do we note the effects of man's presence, and, even then, not in a way to spoil the unblemished beauty of nature.

Utah was the first state in the Union to make sugar from beets grown on irrigated lands. It was also the first to build a beet sugar factory with American-made machinery.

The Chihuahua, Mexico, Chamber of Commerce, agriculture and mines has subscribed $100,000 for the purpose of drilling artesian wells in the state.

Farmers in the northwestern part of Oklahoma are becoming interested in pumping for irrigation. Several artesian wells have been sunk in Texas and Cimarron counties and have proved an almost inexhaustible supply of water of the purest kind.

Over 1,000 acres of land near Newfield, New Jersey, have been sold to the Skinner Irrigation Company of Troy, New York, and will be cleared and used as a grain and truck farm.

Elberta, Utah.

THE IRRIGATION AGE COMPANY.

What can you secure me the *Breeders' Gazette* for with THE IRRIGATION AGE the coming year?

I like THE IRRIGATION AGE very much and couldn't get along without it.
(Signed) FRED E. LARSON.

Norden, Nebr., Dec. 24, 1910.

IRRIGATION AGE, Chicago, Ill.

Gentlemen: Enclosed find $1.00 for THE IRRIGATION AGE one year and the Primer of Irrigation. Mail the same to Anton Poitevin, Jr., Idaho Falls, Idaho. I appreciate THE IRRIGATION AGE very much.

Yours very truly,
(Signed) ANTON POITEVIN.

Don't Buy Auto Tires That Hook to the Rim

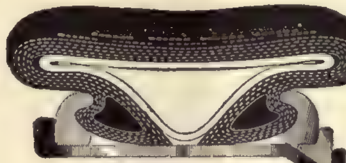
Motor car owners now are using 500,000 Goodyear No-Rim-Cut tires. They are so popular that our tires sales trebled last year.

And 64 leading motor car makers have contracted for them this year.

These are the hookless tires—the tires that can't rim-cut—the tires 10 per cent oversize.

They are saving motor car owners millions of dollars by cutting tire bills in two.

The No-Rim-Cut Tire



The Ordinary Tire

These two tires—the No-Rim-Cut and ordinary—are fitted on the same rim. This is the standard rim for quick-detachable tires, also for demountable rims.

The difference is this: The removable rim flanges are set to curve outward when you use a No-Rim-Cut tire. They must be set to curve inward—as shown in the picture—when you use an ordinary tire.

These removable rim flanges can be set either way by slipping from one side to the other. So Goodyear No-Rim-Cut tires involve no change in the rim.

Rim-Cutting Impossible

The No-Rim-Cut tire, when deflated, comes against the rounded edge. Rim cutting is simply impossible. We have run these tires flat in a hundred tests—as far as 20 miles—without cutting the tire in the slightest.

The ordinary tire—the clincher tire—needs to be hooked to the rim. The rim flanges must be set to curve inward, to grasp hold of the hook in the tire. That is how old-style tires are held on.

Note how that hooked flange digs into the tire when deflated. That is what causes rim-cutting. That is why a new tire may be ruined by running a few hundred feet on a deflated tire. That rim-cutting usually adds one-fourth to one's tire cost.

How We Avoid It

We have invented a tire with an unstretchable base. We vulcanize into the base 126 braided piano wires. Nothing can possibly force this tire off until you unlock and remove the rim flange.

When this tire is inflated the braided wires contract. The tire is then held to the rim by a pressure of 134 pounds to the inch.

That is why hooks are not needed. Not even tire bolts are needed. The tire can't come off because the base is unstretchable.

We control this feature by patent. It is the only way known to make a safe, practical tire which doesn't need to be hooked to the rim. It is the only sort of tire which you will buy when you know the facts. For the worry and damage of rim-cutting is now an utterly useless waste.

GOODYEAR
No-Rim-Cut Tires

Tires 10% Oversize

Goodyear No-Rim-Cut tires are made 10% oversize. The flare of the tire permits that when the rim flanges turn outward.

We give you that 10% oversize without any extra cost. That means 10% extra carrying capacity. It means, with the average car, 25% more mileage per tire.

Most tires are overloaded by the extras one adds to a car. The top, glass front, gas tank, extra tire, etc., load the tires beyond the elastic limit. That is the cause of blow-outs. It is the cause of one-fourth of all tire expense. This oversize avoids that.

These No-Rim-Cut tires—these oversize tires—now cost the same as other standard tires. They used to cost one-fifth extra.

These two features together cut tire bills in two. You can get them without any extra price by insisting on Goodyear No-Rim-Cut tires.

Our new Tire Book tells scores of things which motor car owners should know. Write us to send it to you.

THE GOODYEAR TIRE & RUBBER COMPANY

Eighty-third Street, AKRON, OHIO

Branches and Agencies in All the Principal Cities — **We Make All Sorts of Rubber Tires**

(118)

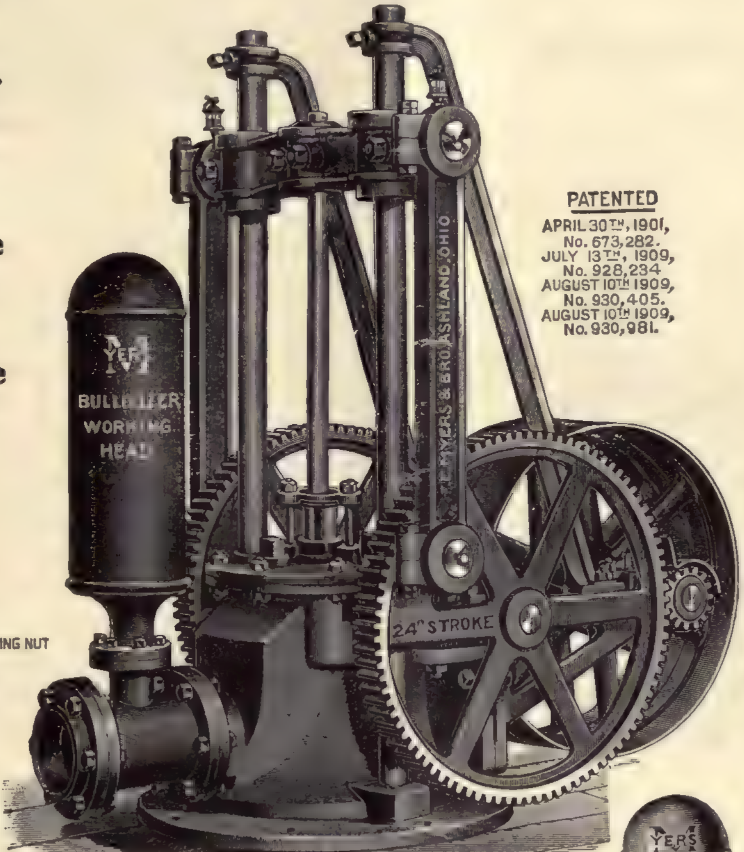
Myers Power Pumps
Working Heads, Pumping Jacks, Cylinders, Etc.

PATENTED

The Myers Bulldozer Power Working Heads For Deep Wells

Length of Stroke 5 to 24 inches

Size of Discharge Up to 6 inches



PATENTED

The Myers Bulldozer Power Pumps For Shallow Wells

Double Acting Length of Stroke 5 to 20 inches

Size of Cylinders 2½ to 6 inches

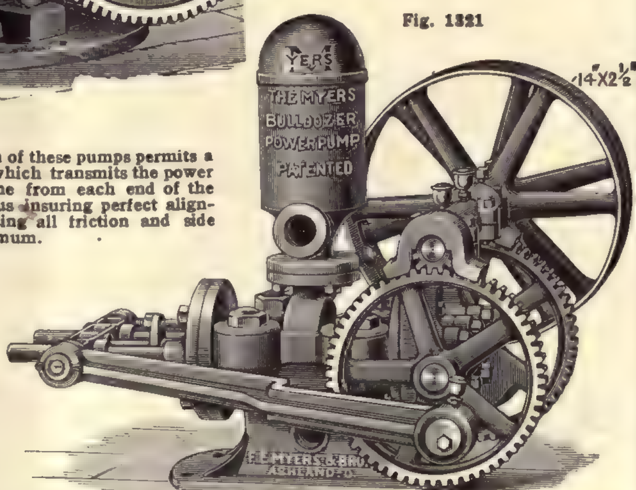
Size of Discharge Up to 4 inches

Capacities 600 to 7200 Gallons per Hour

Th construction of these pumps permits a double gearing which transmits the power in two lines—one from each end of the same shaft, thus insuring perfect alignment and reducing all friction and side strain to a minimum.

Write for Catalogue and Prices

Fig. 1321



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Kingman & Co.,	Peoria, Ill.
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Kingman Implement Co.,	Omaha, Neb.
Parlin & Orendorff Imp. Co.,	Portland, Ore.
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Eastern Farmers please write direct to the Manufacturers

AMERICAN SEEDING MACHINE CO., (Inc.)
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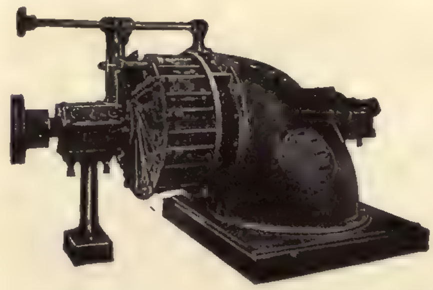
GRAIN DRILLS

SAMSON TURBINE



When the PUMP cannot be direct connected to the turbine shaft, the power is usually transmitted by gears, shafting, etc. On account of the HIGH SPEED of the SAMSON, for a given power, lighter and consequently CHEAPER transmission machinery can be used.

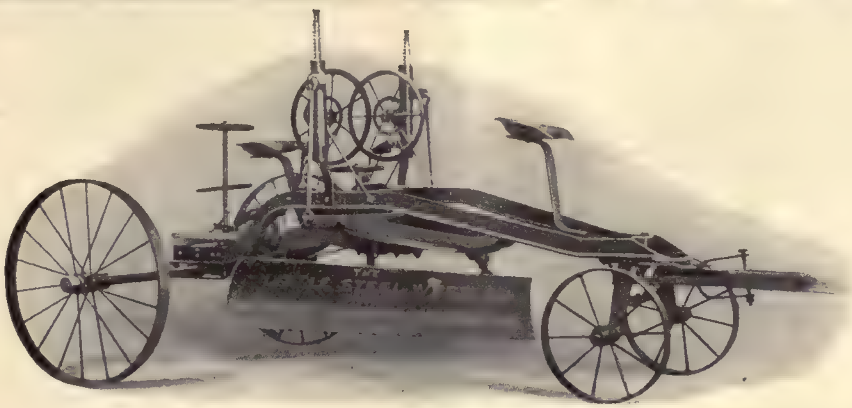
JAMES LEFFEL & CO.

Springfield, Ohio, U. S. A.

316 Lagonda Street

Here Are the Points

which practical irrigation men MUST notice on the LITTLE WESTERN GRADER AND DITCHER



1. High arched frame which gives strength and provides AMPLE CLEARANCE for all angles of blade adjustment.
2. The "FLOATING" type of blade mounted on a ring and so thoroughly BALANCED that it is easily and quickly manipulated with one hand.
3. It has the pivotal rear axle which sets to prevent skidding on heavy side draft.
4. It has the EXTENSION REAR AXLE which enables it to do the varied work done by our larger graders. No small ditcher is competent to do good work without such an axle.
5. It has FOUR wheels which are ESSENTIAL for even work and light draft.

Write for our printed matter on every class of earth handling and ditching machinery

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Twenty-sixth Year

THE IRRIGATION AGE

VOL. XXVI CHICAGO, APRIL, 1911. NO. 6

THE IRRIGATION AGE

With which is Merged

MODERN IRRIGATION — THE DRAINAGE JOURNAL
THE IRRIGATION ERA — MID-WEST
ARID AMERICA — THE FARM HERALD

D. H. ANDERSON
PUBLISHER,

30 No. Dearborn Street, - - CHICAGO
Old No. 112 Dearborn St.

Entered as second-class matter October 8, 1897, at the Postoffice at Chicago, Ill., under Act of March 3, 1879.

D. H. ANDERSON, Editor

ANNOUNCEMENT.

"The Primer of Irrigation" is now ready for delivery. Price, $2.00. If ordered in connection with subscription, the price is $1.50.

SUBSCRIPTION PRICE

To United States Subscribers, Postage Paid,	$1.00
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Official organ of the American Irrigation Federation. Office of the Secretary, 212 Boyce Building, Chicago.

Interesting to Advertisers.

It may interest advertisers to know that The Irrigation Age is the only publication in the world having an actual paid in advance circulation among individual irrigators and large irrigation corporations. It is read regularly by all interested in this subject and has readers in all parts of the world. The Irrigation Age is 26 years old and is the pioneer publication of its class in the world.

Send in Your Orders Now.

The "Primer of Hydraulics," which is now being published in monthly installments, will be ready, bound in cloth, about December next, and will be sold at $2.50 net. To give our readers an opportunity to acquire this very valuable work on Hydraulics at a discount, the publisher has decided to accept orders for all renewals of subscriptions, or all new subscriptions to THE IRRIGATION AGE, including a cloth-bound copy of the "Primer of Hydraulics" for the sum of $3.00. This is a substantial saving for our friends and it is hoped that every one when renewing his subscription will avail himself of this opportunity.

The Department of Correspondence Now Open.

THE IRRIGATION AGE desires to call again the attention of its readers to the fact that a correspondence, question, and answer department has been added to the editorial equipment and that any reader may send any inquiry regarding technical points in irrigation or hydraulics to this office, which inquiries will be duly answered.

The editor cannot warrant that he will be able to answer any or every question, but any question pertinent to irrigation will be published, if possible, with an answer; but should this not be done then there is little doubt that among the many thousands of readers of IRRIGATION AGE there will be some one who possesses the knowledge or experience who will answer the inquiry.

There is nothing like trying. Just send in your inquiry and await results.

A Very Encouraging Communication.

Elsewhere in this issue appears a very interesting letter from Professor Montgomery Moore, who has forsaken the classic rooms of colleges and has gone back to land for the purpose of acquiring health and wealth. His experiences as related in his letter are exceedingly vivid and should appeal with peculiar force to all those who have taken up irrigated land recently or intend to do so in the future.

The fact which looms up with greater force than any other is this: that if a man of as little practical experience in husbandry as Professor Moore is able to make a success in building up a successful irrigated ranch then why should men who are more or less used to hard work in the field and farming hesitate to take hold of the numerous opportunities offered to acquire one of the rich patches of land where irrigation assures a certain and abundant crop each year?

THE IRRIGATION AGE takes this opportunity to thank Mr. Moore for his splendid letter and hopes that we shall have the pleasure of further correspondence from him, as well as from others of our readers who are willing to give an account of their experience for the benefit of those who are less experienced or entirely new in the business. An interchange of ideas and experiences in this way is of the greatest practical value and we hope that our readers will make free use of our columns for this purpose.

How to Study the "Primer of Hydraulics."

The continued articles on the "Primer of Hydraulics," which have been appearing in THE IRRIGATION AGE since December, 1910, form the ground work of a very valuable book which will be complete in December of the present year; it will then be put into book form and placed on the market.

This work on hydraulics is of especial interest and importance to our readers who, as a matter of fact, are all more or less interested in hydraulics, and THE IRRIGATION AGE in thus providing a splendid opportunity for the obtaining of a knowledge of the principles and methods of practical application of hydraulics, is keeping the interest of its readers in the foreground. There are some good books on this subject in existence now, but they are all of a very technical character, so that the plain business man or irrigation contractor is unable to study them understandingly.

Mr. Smith, the author of the "Primer of Hydraulics," however, has developed the happy faculty of clothing his treatise in such simple language and in describing the principles so clearly that anyone with a plain, common school education can follow the subject step by step.

To take up the study of hydraulics successfully the following hints are given by the author: There is nothing in the work except what is essential to a full and complete understanding of the subject. Hence the interested student must read, study and digest everything offered. This applies to the mathematical principles particularly, as they form the basis of future application of hydraulic principles to practical problems, and the best way to study them is to take the given problems which are worked in the various issues, and solve them independent of the printed solution, but compare the work with that of the author. Then select similar problems of your own making and apply the given principles for their solution. To fix them in your mind it is necessary to read and reread the articles and to solve problem after problem. In this way proficiency will soon be acquired.

Economy in the Use of Water for Irrigation Necessary.

The Science of Irrigation is as yet hardly out of its baby shoes, and it goes without saying that the next ten years will witness a tremendous development in this direction. As the principles of irrigation are better understood and practised, the benefit of them will become apparent more and more. As a matter of fact irrigation should by no means be confined to arid or semi-arid countries, but can be and should be applied judiciously everywhere, where farmers are raising vegetation. Even countries having an annual rainfall of 40 inches or more will experience at times the effect of a drouth which will cause a complete or partial failure of crops; this could be relieved or entirely prevented where a partial system of irrigation is maintained so that in case of a failure of rains to arrive at the right time the farmer can turn his water into his land and supply the deficiency.

As the irrigated areas are constantly increasing the matter of economic use of water is receiving attention. This is a very important subject and should be followed up with the most persistent efforts. If conservation of natural resources means anything it means that there should be no waste; it does not mean that our forests or water-falls should be fenced in and kept from being used; this would be utterly foolish and keep the people from their heritage; but it means that our national resources should be so handled that they will serve the present generation as well as succeeding generations and hence economy in their use is an imperative necessity.

Economy in the use of water for irrigation purposes is necessary in order to expand the number of acres available for irrigation. It is easily understood that when the pioneers in irrigation took hold and developed projects it was done on lines of the least resistance and least cost. Thus water was led along rough ditches to the nearest land and the tracts thus irrigated produced splendid results. No one made inquiries as to the quantity of water which actually leaked away from the ditch and was thus wasted. As the value of irrigated land is constantly rising the value of the water thus wasted becomes apparent and means are discussed and adopted to conserve this wasted water; how to accomplish this result to the best advantage is one of the principal problems in irrigation at the present time.

Doubling and Trebling the Duty of Water in Irrigation.

The following article has been taken from the news notes of the Colorado Agricultural College, Ft. Collins, Colo., written by E. B. House:

How many farmers are there in the country who know what is meant by the term "Duty of Water?" Not many. Yet they have been living in an arid section and irrigating their fields for years. They have seen the value of water increase year after year, and they know that water in a reservoir is like money in a bank, and should be used when and where it will do the most good, and made to go as far as possible.

One farmer uses a certain head of water and with it covers five acres of his farm in a day. Another farmer uses the same head and irrigates only 2½ acres with it. The duty of the water in the hands and on the land of farmer No. 1 is double the duty in the hands and on the land of farmer No. 2.

It behooves every farmer, then, to know what duty he is getting out of his water, and, if he finds that he is not up to the standard, he may take the necessary steps to improve the position of his ditches or may, during the fall and early winter, cut off the high spots and fill in the low spots of the field and in this way increase the duty of his water two, three, and even fourfold.

There are two general ways of speaking of the duty of water. One is to state the number of acres a second foot of water will take care of, and the other is to speak of the number of acre feet of water used per acre.

We used to figure that land in this section needed one second foot of water for every 40 acres, and in this case the duty of water was 40 acres per second foot. Later we raised this duty to 60 acres per second foot; then we made the duty 80 acres per second foot, and for a long time it was the custom to provide a second foot of water for each 80-acre tract. Now we are figuring the duty of water to be 100 or 120 acres per second foot.

Can we do better than this? We certainly can, for in southern California, where water is scarce and valuable, they make a second foot of water take care of 300 acres, and where subirrigation, by means of underground pipes, is used, the duty in some cases has reached 1,000 acres per second foot.

This method, however, of figuring duty is not the best by any means, for it presupposes a continuous flow of 1 second foot throughout the irrigating season. The farmer when he irrigates usually wants more than a second-foot head, and he uses it for a few days or weeks and then uses no water

at all for a period. Hence, the second way of stating it, which is in acre feet per acre, is usually the best way.

A second foot of water running for 24 hours delivers approximately two acre feet. (To be exact it delivers two acre feet in 24 hours, 12 minutes.) Let us say the irrigating period is 120 days, and one second-foot would deliver in that time approximately 240 acre feet. If this were applied all at once to 100 acres, it would cover it to a depth of 2.4 feet, and we would say that the duty of water in this case, is 2.4 acre feet per acre.

The duty of water, then, in acre feet per acre, is the number of acre feet of water applied to each acre of land, during the entire season. It varies the country over, from one acre foot per acre, to 10 or 12 acre feet per acre.

Why not make an experiment, then, Mr. Farmer, and see what duty you are getting from your water. It will pay you.

The suggestions in the above article are timely and important to every man interested in irrigation, for if the same amount of water formerly required for 40 acres can be made duty for 80 acres or more, it means a tremendous stride forward.

The Irrigation Age welcomes every suggestion in the line of true economy, and will spare no efforts to assist in this direction. A better knowledge of the principles of hydraulics is, however, essential and we are in a position to give that to our readers in a few months. We feel that the Colorado Agricultural College is doing a good work in the publishing of its news notes and we are glad to co-operate with it in the purpose of improving the results of general irrigation.

Transformations of Water in the Economy of Nature.

It is not strictly true that the total amount of water on this earth is a constant quantity, for the reason that water will temporarily enter into combinations where its function as water is lost. This is particularly true regarding crops which require a large amount of water for their growth transforming it into sugar, starch and other substances. Of course, when such crops, fruits or vegetables, reach their final stages in consumption the bound water will be released and finally find its way into the general storage reservoir of nature which is the ocean. Thus the mechanics of nature's water supply are easily understood. The motive power of lifting the water from the ocean to the top of the mountains is, of course, the sun. It is a fact that the power of the sun's rays evaporates thousands of tons of water per second from the various oceans in the form of an invisible vapor which rises in the air on account of its lightness; on reaching higher altitudes where the temperature of the air becomes cooler the air is unable to carry as much water vapor and a portion of the latter is condensed into fine drops which form the familiar clouds in the sky. As these clouds undergo farther reduction in temperature, more vapor is condensed and the clouds become finally so heavy that the air no longer can carry them and precipitation is the result either in the form of rain, hail, snow or dew. The air is never completely free of moisture as it would be impossible to live in air devoid of water vapor. There is, however, a point beyond which air will not carry water vapor and this is called the point of saturation. This point varies with the temperature of the air; the warmer the air the more vapor it will absorb. Thus when winds carry the warm air from the tropical zone into colder regions formation of clouds takes place because the colder air refuses to carry the excess of moisture.

On the Island of Hawaii these phenomena may be observed to very good advantage. There is a mountain range running from north to south through the island; the northeast trade winds blow for about nine months in the year carrying a balmy air saturated with water vapor which has been taken from the water of the Pacific ocean; when the winds strike the cooler highlands and mountains of Hawaii condensation sets in and clouds form causing abundant precipitation; but this just happens on the east side of the mountains; the west side of the range is entirely barren as the air having been robbed of its moisture by the eastern slope refuses to give up any more moisture in the shape of rain or dew. Thus the island of Hawaii presents on its eastern slope the features of a paradise, while its west coast has the aspect of a desert.

It is seen thus that the water supply which nature has provided for instance for these United States, has its power house in the sun, its boilers in the lakes of the United States and the surrounding oceans and its natural storage in the vastness of the Rock Mountains. The travel of the water is thus: From the ocean in the form of vapor or cloud to the mountains where it is precipitated either as rain or snow. Hence the rain by the force of gravity first forming little brooks which finally gather into rivers and travel down, down to the ocean, where Old Sol remains busy to keep the process agoing.

The water in the form of snow is a wise provision in nature as this is kept, so to speak, in cold storage until the hot sun of the summer months does some more necessary work in melting the snow at a time when natural precipitation is at its minimum, and the melting snow in the mountains thus provides a means of feeding the brooks and creeks and supplying the life-giving and life-sustaining fluid to man, beast and plant. This shows also the necessity of keeping the mountain slopes well timbered to prevent the erosion of the soil by the rapid flowing waters.

Another factor in the characteristics of water must be reckoned with, especially by the "irrigationist" if we may coin that word with the definition that it means everyone who is interested in irrigation problems. This is that a heavy percentage of water is lost on its way from the mountains to the ocean by following subterranean passages. Thus although the water itself is not lost, for there is nothing lost in the economy of nature, it fails to do any useful work on its way down to the ocean and may be stranded by getting boxed up in subterranean basins. These are tapped frequently successfully by wells and the water thus obtained will do duty in various ways, but it is seen that by the water being allowed to escape below the natural surface of the ground it will have to be lifted from its hiding place by pumps which is expensive, while the force of gravity is free. Hence it will be a wise move to watch the more important rivers and irrigation channels and reduce this leakage to a minimum.

Personal Representatives of Governor Harmon

Governor Harmon, of Ohio, would do well to call off some of his simple-minded friends who are talking about his candidacy for the presidency. One individual in particular who poses as special agent of the United States Census of Irrigation, of the name of Edward F. Bohm, has made the statement that he is to be Secretary of the Interior under Governor Harmon when he is elected president.

We do not care to discuss the mental status of the man Bohm, as this statement possibly indicates all that our readers would care to know about him. It, however, will do no

good to Governor Harmon to have this class of representation.

The man Bohm posed at a number of the Irrigation Congresses as the personal representative of the Governor of Ohio, in fact, emphasized his position as personal representative so strongly that it caused laughter among those with whom he came in contact. At any rate, it is considered a matter of very poor taste for Bohm to talk about Governor Harmon for the presidency in view of the fact that he is holding a position under a Republican Administration which was secured for him by an acquaintance, (whom he has never taken the trouble to thank for the kindness).

A few such representatives as this throughout the country would do Governor Harmon more harm than good, and we would suggest to him that he call off some of these would-be "personal representatives" and place his campaign in the hands of men of more mature judgment and better political sense.

THE LOWER YELLOWSTONE IRRIGATION PROJECT.

The Secretary of the Interior has issued the following order for the purpose of relieving the present situation on the Lower Yellowstone irrigation project, Montana, pending the issue of public notice modifying the notices heretofore issued:

A stay of proceedings looking to the cancellation of entries or water-right applications because of failure to make payment will become effective as to all water-right applications subject to public notices heretofore issued upon the payment of $1.50 per acre on or before March 31, 1911, subject, however, to compliance with the conditions of a public notice to be heretofore issued making a building charge which shall be between $53 to $55 per acre. Such stay of proceedings shall remain in effect until further announcement by means of a public notice or otherwise. Water will also be furnished for the year 1911 to others, upon the filing with the project engineer of proper applications subject to the terms of this order and upon the payment of the sum of $1.50 per acre under the conditions herein provided. No water will be furnished in any case unless the holdings of the applicant for water shall have been conformed to the farm unit shown on the approved farm unit plats.

Upon failure to make payment as herein required on or before March 31, 1911, the entry or water-right application, or both, as the case may be, which would otherwise be subject to cancellation will be promptly canceled without further notice.

All applications for water rights filed under the provisions of the notices heretofore issued and for which the payment necessary to avoid cancellation shall have been on or before March 31, 1911, shall be continued in effect under such prior notices, and water-right applications may be filed on or before March 31, 1911, under the provisions of the public notices heretofore issued if accompanied by the payments required thereunder and shall be entitled to continue under the terms thereof.

The intent of this order is to permit all persons who so desire to obtain the benefit of the former building charge of $42.50 per acre by making the necessary payments on or before March 31, 1911, or by filing new water-right applications accompanied by the necessary payments on or before that date; and that all other persons under the project who desire to be furnished with a water supply shall pay in advance the sum of $1.50 per acre and be subject to the conditions of the public notice to be hereafter issued.

DAMS ON SAND FOUNDATIONS: SOME PRINCIPLES INVOLVED IN THEIR DESIGN, AND THE LAW GOVERNING THE DEPTH OF PENETRATION REQUIRED FOR SHEET-PILING*

All textbooks on the subject of dams which the writer has had occasion to examine emphatically discourage the idea of attempting to construct permanent dams on any kind of foundation other than solid rock bottom, although most of them contain one or more illustrations of the types which are generally designed for construction on alluvial soils, such as firm beds of clay, or deep strata of cemented gravel (commonly called "hardpan"), or on sand, provided the conditions are such as to permit the construction of a curtain, or cut-off wall, of sheet-piling, or a core-wall of masonry or of clay puddle, so as to penetrate a firm stratum of denser material.

The frequent failures of sheet-pile dams, on the "bottomless" sand beds of Western streams, have served merely as the basis for warnings, and not as incentives to study and investigation, on the part of the authors of the standard books on the subject of dams, which the practicing engineer consults for information and precedents.

Many crude brush and log dams were constructed, and maintained successfully for long periods of years, on these "bottomless" sand beds, by practical and resourceful pioneers who had no theories or precedents other than the example of the beaver.

The operations of British engineers in contending with sand, during the construction of the large Government irrigation works in India, furnish some expensive precedents for the expenditure of unlimited funds; but, our pioneer western irrigation surveyors were confronted with the problem of coping with streams having apparently bottomless beds of shifting sands, with funds which were generally limited to the few dollars which the pioneer settlers could borrow on their personal characters and future prospects, because their "desert" homesteads, which now rank among the finest farms in the country, were in those times practically worthless as collateral security.

The writer has spent most of his life in the sandy regions of the West, and has had occasion to seek information on practical methods of dealing with treacherous sand, as a young engineer whose ambitions were involved in the successful solution of such problems; therefore after several years of professional familiarity with it, the term, "quicksand," has less terror for him than it ordinarily arouses.

The following paper is submitted for the consideration of those who have occasion to deal with such problems, not in the sense of establishing authoritative rules, but with the hope of arousing discussion, from which it may be the writer's privilege to learn things which have not been brought out in his own experience.

Seepage, Percolation, and the Movement of Underground Waters.—The velocity of flow which occur in seepage, percolation, or in the forced flow of water through sand, gravel, clay, loam, or other pervious materials, are affected by coefficients of capillary attraction and frictional resistance.

The effects of these forces are co-existent, but not identical, and they vary inversely as the sizes and proportion of the interstices between the particles of the alluvium. In fine clay, therefore, in which the interstices are of infinitesimal size, it is almost impossible to force an appreciable flow of water through a thickness of a few feet. If water finds passage, however, through any point of variable density, or any fissure or shrinkage crack, a barely appreciable trickle, under pressure, will rapidly disintegrate and abrade the clay, and, as the stream thus increases in volume, will quickly undermine or destroy any structure which may be dependent on the density of the clay for its stability.

In the case of sand or gravel, with relatively large interstices, the forces of friction and capillary attraction offer less resistance, and therefore water may be forced through them with an appreciable velocity of flow.

In any alluvial soil in contact with, or subject to the pressure of, water, a movement of water through it is inevitable, whether it be the infinitesimal progress of seepage through fine clay, percolation through sand, the flow through

*A paper by Arnold C. Koenig Proceedings American Society of Civil Engineers, Vol. XXXVII, p. 32.

an embankment of broken stone, or the rush of water through the crevices and open spaces between large boulders, the safe permissible velocity of flow must be confined to that which the material will stand without the movement, displacement, or abrasion of the particles which compose it.

Turneaure and Russell* refer to numerous experiments which have been carried out at various times to determine the velocity at which water will flow through sands and gravels of different grades of fineness. These experiments were made for various purposes, such as to determine the dimensions of sand filters, the probable supply of water from wells, etc.

D'Arcy, Hagen, Hazen, and others, found that for grades of sand varying from very fine sand to fine gravel, the velocity of flow closely followed the law of flow through capillary tubes.

In considering the flow of seepage, or ground-waters, we are not concerned in refinements of experimental data which indicate the influence of temperature on the rate of flow; therefore, after eliminating these, the result of the experiments is the following formula:

$$V = 8{,}200\ d^2s.$$

In which V = the velocity of flow, in feet per day.

d = the effective size of the sand grains (varying from 0.1 mm., which is very fine sand, to 3 mm., which is fine gravel); and

s = the slope of the groundwater surface (hydraulic-gradient).

According to this formula, the velocity of flow of groundwater, through fine sand having an effective size of grains of 0.1 mm. and a general slope of ground-water surface of 5 ft. per mile (hydraulic gradient = 0.001), would be:

$V = 8{,}200\ d^2s = 8{,}200 \times 0.01 \times 0.001 = 0.082$ ft. per day.

The velocity of flow through gravel having an effective diameter of grains of 3 mm. and a general slope of water surface of approximately 50 ft. per mile (hydraulic gradient = 0.01) by this formula would be:

$V = 8{,}200\ d^2s = 8{,}200 \times 9 \times 0.01 = 738$ ft. per day = approximately 0.0085 ft. per sec.

The Report of the Massachusetts State Board of Health for 1902 contains the results of a series of experiments to determine the velocity of flow of water which it is possible to obtain through screened gravel, of various grades of fineness, assuming 40 per cent porosity. These results are shown in Table I.

From an examination of the figures in Table I, it becomes evident that all the foregoing experimental data are, at best, only rough approximations. The formula: $V = 8{,}200\ d^2s$, which was determined from experiments with various grades of sand, gives much larger results than the quantities in Table I for screened gravel. To modify the formula so as to produce the results given in that table would involve a variation of the coefficient (8,200) between 6,222 (for d = 3mm. and s = 0.0005) to 940 (for d = 35 mm. and s = 0.01).

For many years the water supply of the Citizens Water Company of Denver, was secured from about a mile of timber crib, 30 in. square in section, and about a mile of perforated 30-in. pipe both submerged in the sands of the Platte river at depths varying from 14 to 22 ft. The timber crib was open at the bottom, so that, with the openings in the cribbing, perhaps one-half of its superficial area was open for the inflow of water, while, for the pipe line, the net area of the perforations would probably bear a much smaller ratio to the circumferential area of the pipe. It may be assumed, therefore, that on the two miles of combined crib and pipe line the total area of inlet openings would approximate 25 per cent of the surface area exposed to contact with the water-bearing sand, thus affording a total net area of inlet openings of 26,000 sq. ft. The water was led away through pipes by natural flow, and the supply thus secured was between 400,000 and 450,000 cu. ft. per day; which is equivalent to 13 cu. ft. per day per square foot of inlet opening, or a velocity of inflow of 0.00015 ft. per sec.

Being submerged under the bed of the river at depths varying from 14 to 22 ft., these cribs are entirely surrounded by water-bearing sand; therefore, as the water may approach radially from every direction, it must be assumed that the maximum velocity of flow through the sand is less than one-fourth of the velocity of inflow through the perforations and openings.

Assuming an average head of 16 ft. as acting on these cribs, the spouting velocity of water entering the pipe through one of the perforations from a free body of water under the pressure due to a 16-ft. head ($V = \sqrt{2gh}$) would be 32 ft. per sec., while the actual average velocity of inflow is only 1/200000 of such rate.

All formulas for the velocity of flow of water, under special conditions, are modifications of $V = \sqrt{2gh}$, with coefficients introduced to provide for the special conditions of frictional resistances encountered. In working backward from the results indicated above, so as to determine the special coefficient which must be applied to the formula to adapt it to this special case, we obtain the following:

$$V = 0.00004\sqrt{h}.$$

The lack of harmony in the results indicated in all the foregoing data makes it impracticable to devise even an approximate formula for the determination of the magnitude of the force produced by the flow of seepage water under a line of sheet-piling. Even if it were possible to determine the relative effects of frictional resistance and capillary attraction on the flow of water through interstices of such an infinite variety as is afforded by the range of materials from fine clay to large boulders, such "hair-splitting" refinements of calculation would have very little practical value for this purpose, on account of the uncertainties which attend the determination of the variations of actual conditions to be met.

Causes of Failure of Sheet-Pile Dams.—Failures in sheet-pile dams have generally occurred in those of the spillway or overflow type, which are commonly called diversion weirs. The seepage water which finds its way under a line of sheet-piling tends to buoy up the particles of sand on the down-stream side, while the surface of the river bed is frequently subjected to a variable degree of scouring action from the current of water which spills over the crest. These two forces combined move the finer particles of sand first, then, as the interstices in the sand gradually increase is size, the upward flow of seepage water increases, both in force and volume, and the destruction of the dam is in progress.

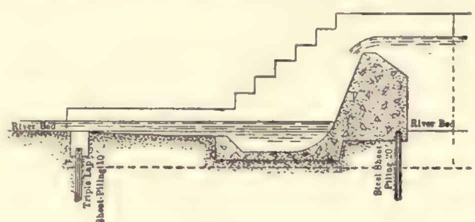


Fig. 1.

It is customary with many engineers to make the length of sheet-piling such that the depth of penetration below the bed of the stream will be approximately equal to the head of water to be impounded by the dam or weir, and it is likely that many of the failures of such structures, which have been attributed to "unknown" causes, were due to the inadequacy of the cut-off wall under the structure—more often, however, on account of carelessness in driving and faulty alignment than from insufficient depth of penetration.

Length of Sheet-Piling Required.—Capillary attraction and surface friction, in the interstices between the grains, are forces of such magnitude in retarding the velocity of seepage flow through sand, or other pervious materials, that, with reasonable depth of penetration of a curtain-wall of sheet-piling, the direct pressure which may result from any reasonable head of water impounded by the dam cannot produce a velocity of seepage flow sufficiently rapid to move the fine particles of sand without the added force of the overflow current flowing on the surface of the river bed; therefore, in designing the dam or diversion weir, adequate provision must be made to counteract the effects of both of these forces.

Assuming that the force of capillary attraction effectively resists the pressure head of the impounded water, in its natural function of producing an acceleration of seepage flow, then the body of sand on the down-stream side may be considered as a mass which is held together by the force of capillary attraction, and that the pressure due to the head of water on the up-stream side passes under the line of sheet-piling and acts on a wedge-shaped mass of sand on the down-stream side.

The hydrostatic pressure at the bottom of the sheet-

*In "Public Water Supplies."

piling is exerted equally in all directions, but, we are here concerned only with the force which acts in an upward direction. The tendency of this force to buoy up the mass of sand is resisted by the excess weight, or specific gravity, of the solid particles which compose the body of sand, after deducting the percentage of voids which are taken up by the water.

Let h = Maximum head of water on upstream side,
d = Depth of penetration of sheet-piling,
s = Specific gravity of material penetrated,
x = Proportion of solids.
For average sand, $s = 2.65$ and $x = 1 - 0.40 = 0.60$

$$\text{Then } b = \frac{h}{s \times x} = \frac{h}{2.65 \times 0.6} = \frac{h}{1.59} = 0.629\,h,$$

which is the theoretic penetration.

This equation provides for the depth of penetration at which the excess hydrostatic pressure on the up-stream side is theoretically counterbalanced by the specific gravity of the depth of material on the down-stream side, in sand of such size and porosity that the combined effect of friction and capillary attraction is a maximum.

A length of sheet-piling which provides for a depth of penetration equal to the maximum head at flood-stage, therefore, involves a factor af safety of only 1.59 (with a tight wall of sheet-piling in perfect alignment) applied to the theoretic minimum. This is manifestly inadequate for such variable and uncertain conditions as are likely to be encountered.

Where the workmanship, alignment, and depth of penetration of a curtain-wall of sheet-piling are such as to insure that there will be no marked "leakage" flow through openings, or places of variable density, silt and matter carried in suspension by the current of the stream will settle in the quiet pool of water impounded by the dam, and gradually seal up the interstices in the sand, until the bed of the stream becomes practically impervious. This has been thoroughly demonstrated in irrigation canals constructed in sandy soil, and by the fact that the graded sands used in the filter beds of many of our larger cities require frequent renewals, or removal, for the purpose of washing out such accumulations, in order that even the customary slow rate of percolation may be maintained.

No material, other than solid bed-rock, offers a more secure support than sand which is properly confined; therefore, to make it serve as a safe foundation for a permanent dam is entirely a problem of making adequate provision against the only disturbing element—a current of flowing water.

For dams which are to be constructed on a sand foundation, and embody the special features of construction recommended in a subsequent part of this paper, the writer suggests the following empirical rules:

$d = 2.5\,h$. For heads up to 8 ft............(I)
$d = 2\ \ h$. For heads up to 15 ft..........(II)
$d = 1.6\,h$. As the minimum, in any case..(III)

Equation (III) uses the proportion of excess weight, due to the specific gravity of the sand, as a coefficient instead of as a divisor. It provides a factor of safety of 2.5 under normal conditions of low head, and, as the velocity of seepage flow through sand probably varies as some function of the square root of the head, the factor of safety is correspondingly increased for higher heads.

Special Features of Construction.—The horizontal distance through which seepage water must flow, after passing under a line of sheet-piling, before it reaches an outlet at the surface, is an important element in retarding its force to such extent that there will be no erosion, or movement, of the sand composing the surface of the river bed. It is especially important below spillways, or dams of the overfall type, where the velocity of current from the overflow of the dam may already be such that erosion of the finer particles of sand takes place; therefore, the added impetus of upward percolation would produce a dangerous condition of erosion and the inevitable destruction of the dam.

An apron below a dam serves, not only to resist the shock of abrasion of falling water, but also to seal the bed of the stream, so that the seepage water which finds its way under the curtain-wall of sheet-piling, must flow diagonally upward beyond the limits of the apron before issuing. The width of such apron, therefore, is an important element in fixing the practical factor of safety of the structure, and should not be overlooked.

Aprons for spillways, diversion weirs, and dams of the overfall type, should be submerged, so as to form a water-cushion to absorb the shocks of falling water, ice, and debris. Such water-cushion should have a depth equal to one-quarter, and preferably one-third, of the total height of overfall, and a down-stream width of not less than 1½ times the total height of overfall, with the outer edge forming an apron, sloping upward, and extending down stream for a distance of not less than 1½ to 2 times the length of sheet-piling used in the main curtain-wall, ending with, and supported on, a secondary line of sheet-piling of from one-third to one-half the depth of penetration of the curtain-wall.

A special feature of construction, which provides for considerable economy in the quantity of concrete required for a wide apron and, at the same time, provides a greater element of safety against the force of seepage flow than a solid concrete apron of the dimensions stated above, is illustrated in Fig. 1.

The submerged apron should be constructed in the form of a trough, with a depth of not less than one-fourth, and a down-stream width of 1½ times the height of the overfall, and the outer edge should be finished off at, or slightly below the elevation of the bed of the stream. At a point down stream, a distance of about twice the length of the main sheet-piling used (or 4 or 5 times the head), there should be driven a second cut-off wall of tight sheet-piling with a depth of penetration of about one-half that of the main curtain-wall, parallel to the line of the dam, to support a substantial concrete curb which should be finished off at the elevation of the bed of the stream.

The writer wishes to emphasize the statement that: One of the most serious problems involved in the design and construction of dams for rivers with beds of shifting sands is that of providing adequate protection against dangerous erosion of the river bed for some distance below the dam where the erosive action of the current is dangerously magnified by reason of the upward force of seepage flow, under the variable hydrostatic pressure communicated from the head of water impounded on the upper side of the dam.

In the design suggested in Fig. 1, the open space between the edge of the trough forming the water-cushion and the concrete curb supported by the secondary line of sheet-piling provides an open space for the escape of the seepage flow which finds its way under the curtain-wall, while the concrete curb prevents the erosion and removal of the sand, which, in this confined section of the river bed, is subject to the combined forces of upward and horizontal currents.

The approximate general dimensions suggested apply to low dams of the diversion-weir class, such as are used to divert water from wide and shallow streams for purposes of irrigation and power; and the importance of careful and conscientious workmanship on every detail of construction in sand is so self-evident that special mention seems to be unnecessary.

Every dam or diversion weir should be designed in accordance with the practical demands of the exact local conditions which prevail. This involves modifications of any set of general rules, especially for higher heads, that is, for dams which, in sandy rivers, will raise the level of the water more than 12 or 15 ft. For low dams there is a variety of shapes, or cross-sections, from which to choose; but, for higher heads, economy in the matter of the materials involved narrows down the choice in the direction of the curved or ogee form of cross-section.

Under the general rules previously stated, a dam which is designed to raise the level of the water 50 ft., in a river having a bed of sand of unlimited depth, would require a curtain-wall of sheet-piling having a depth of penetration of not less than 80 ft. below the bed of the stream, as the minimum. A dam of this height would probably be designed with an ogee form of curved cross-section. The impracticability of driving a line of wooden sheet-piling to such depth in sand and gravel, and the expense of providing a curtain-wall of steel sheet-piling to such lengths, would suggest a careful analysis of modifications, for the possiblity of eliminating a portion of such construction without impairing its stablity and permanence.

Ample assurance of safety could be attained by using a line of steel sheet-piling of such length as to provide a depth of penetration of 50 ft. under the up-stream side of the dam,

and a secondary line of sheet-piling with a depth of penetration of about 15 ft. under the extreme toe, which should be curved up so as to form a trough at a depth of about 5 ft. below the bed of the river, for a water-cushion. Then, at a point about 200 or 250 ft. down stream, construct a smaller dam, about 15 or 16 ft. in height, with a line of main sheet-piling having a depth of penetration of 30 ft., and embodying all other features of design in accordance with the special features outlined in this paper, to back up the water against the main dam for a proper depth of water-cushion. The seepage flow, which would probably find its way under the main dam in considerable quantities, would issue from the section of confined river bed between the two dams, where the depth and length of the water-cushion thus provided prevents the removal of any sand, because, even during periods of storm flow, the violent abrasive force of the flood passing over the dam would be effectually broken by the extra depth of water-cushion which is provided by the concrete trough at the toe of the dam.

In calculating the proportions of a dam which is to be founded on sand, there is involved the consideration of the hydrostatic pressure against the under side of the dam.

The calculations for the cross-section of a masonry dam founded on bed-rock are based on the assumption of an absolutely water-tight contact between the footings and the bed-rock, therefore the entire cross-sectional weight of the dam may be use in calculating the moment of resistance to overturning.

In a dam of such proportions that the resultant of forces passes close to the toe, the effect of water working its way under the footings at points of defective contact, or through defective joints in the lower courses of masonry, might produce a change in the direction of the resultant such that it would pass outside of the toe. That section of the dam

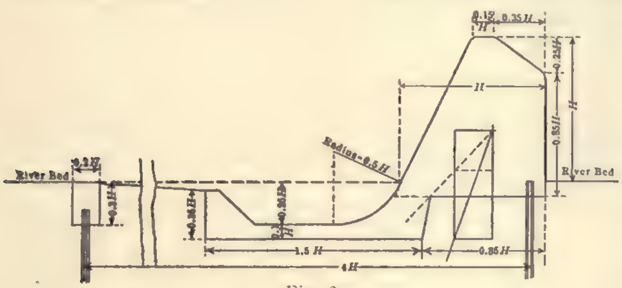


Fig. 2.

would then be in unstable equilibrium, and, unless restrained by other forces, would overturn.

In considering the forces which may act on a dam resting on sand, saturation of the foundation, with upward hydrostatic pressure, is an accepted fact, and, therefore, must be considered as a definite element in the calculations.

As stated previously, the combined effect of friction and capillary attraction offers such marked resistance to the flow of water through sand that the velocity which results from any head, or inclination of surface, is infinitesimal, in comparison with the velocity which would result under similar conditions of head in a body of free water, flowing in an open channel, or through a pipe. The transmission of hydrostatic pressure through a similar medium is similarly resisted, to a slight degree, as will be shown.

The removal of the soil above a stratum of dense clay, which in turn overlies a stratum of water-bearing sand or gravel under artesian pressure, will disclose a moist degree of saturation of the clay such that water will accumulate in small pockets, or sumps, which may be bored or dug to shallow depths of 1 or 2 ft. into the clay. The seepage flow which is thus indicated is absorbed by the soil above by capillary attraction, and is evaporated from the surface; however, no hydrostatic pressure, of measurable magnitude, would be exerted against the footing of any structure resting on such a stratum of clay.

Hydrostatic pressure is directly proportional to the head of water, and time is not a factor in determining its magnitude, hence the coefficient of friction becomes zero. Clay contains a relatively large proportion of voids of infinitesimal size, and, while high head of water pressing against the under side of the stratum of clay which is confined between the porous strata would undoubtedly transmit the hydrostatic pressure of measurable magnitude through such stratum of clay, it is evident that, under moderate heads, the force of capillary attraction (in interstices of such infinitesimal size that they would almost warrant an assumption of molecular friction), is of sufficient magnitude to counteract and practically nullify the effect of hydrostatic pressure.

It may be concluded, therefore, that the force with which hydrostatic pressure is transmitted through alluvial soils is modified by a coefficient which varies as the square, cube, or perhaps the "*n*th" power of the effective size of the interstices, or, inversely as such function of the effective size of the grains.

For the practical purposes of this paper, the probable existence of such a coefficient may be disregarded, because, for the interstices of the sizes which are ordinarily found in sand of 40 per cent porosity, its probable value becomes so small as to be negligible.

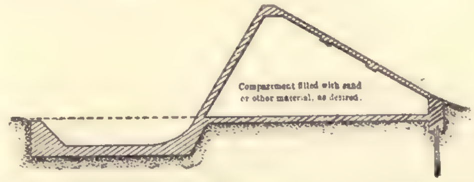


Fig. 3.

The hydrostatic pressure against the under side of any dam of the type and general dimensions illustrated in Figs. 1 and 2 is governed by the head of water on the down-stream side of the dam, because the pressure which is transmitted under the curtain-wall of sheet-piling, from the head of water above the dam, is afforded lateral outlet, therefore its intensity is limited to the depth of resistance, or head, opposing such outlet on the down-stream side.

The hydrostatic uplift per square foot of surface against the base of a dam of the type and general proportions recommended in this paper, therefore, will vary between 25 and 40 per cent of that which would result from the head of water on the up-stream side.

Figure 2 illustrates the general proportions of the spillway section of a dam of the type discussed herein, with all dimensions given in terms of H, the height of the crest above the bed of the river, and assuming a length of spillway such that the maximum height of overflow will not exceed $\frac{1}{5}H$.

The resultant, which is obtained when the calculated weight of the section of concrete is reduced by the total amount of hydrostatic uplift due to a down-stream head $= 0.3\ H$, intersects the base practically in the center, as is shown by the solid line. This would indicate that the design may be modified so as to involve less concrete, but the quantity to be thus saved, in the total cost of a low dam, will not outweigh the desirability of such a factor of stability in a structure of this class.

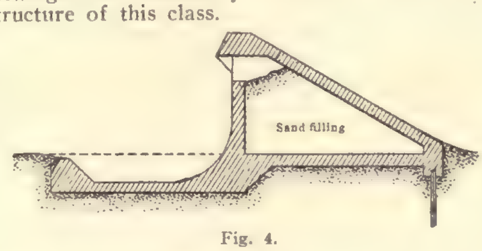


Fig. 4.

The dotted line indicates the resultant which would be obtained if the weight of the concrete were reduced by an amount equal to the full hydrostatic uplift which would result from a head equal to the maximum up-stream head $= 1.3\ H$. This resultant intersects the base outside of the middle third, but well within the toe.

The sloping portion of the top of the dam, on the up-stream side of the crest, is desirable to facilitate the passage of ice and floating debris over the crest, and to reduce the moment of ice thrust during periods of extreme cold when the entire flow of the stream may be diverted for power purposes.

Any increase in the width of the base, with the additional material on the up-stream side of the dam, so as to lengthen the inclined portion, affects the moment of stability

(Continued on page 880.)

CONCRETE FEEDING FLOORS AND BARNYARD PAVEMENTS.

The saving principle of feeding floors has long been recognized by successful breeders and feeders of live stock. The trouble, heretofore, has been to obtain an entirely satisfactory material for floor construction.

Wooden floors kept the feed out of the mud and dust and not only saved every particle of grain, but also prevented wheezing coughs and otherwise temporarily improved the health of the animal. However, in a short time, the best wooden floors rotted out and became infected with disease germs. Often floors had to be burned to free the farm of hog cholera.

In concrete the farmer and ranchman have found an ideal floor material. Such floors not only effect a saving in feed, a shortening in the time of fattening and a decrease in labor, but also afford perfect protection to the health of the animal. Concrete floors do not soak up water and therefore cannot become infected with disease germs. Their surfaces can be easily cleaned and thoroughly disinfected with oils and dips. Rats cannot nest under them. Careful tests have shown that concrete floors, through the saving of grain and manure alone, pay for themselves in the short period of one year.

Illustration Showing Fattening Hogs on Floor.

Feeding floors are merely several sidewalks laid side by side, and the same general rules of construction apply to them. Choosing a site in the lot where the ground is slightly sloping, well drained and wind-protected, and convenient to feed and water.

Excavate to a depth of 12 inches for the drainage foundation, and around the outside edges of the entire floor dig a trench 12 inches wide and 18 inches deep. (This trench, filled with concrete, prevents hog wallows from undermining the floor and keeps the rats from nesting under it.) Fill all of this space (except the trench) to the natural ground level with well tamped coarse gravel, crushed rock, tile culls or brickbats. This fill forms the drainage foundation as for sidewalks.

The floor must be graded or sloped so that water will not collect on it in the winter and so that the manure washings may be caught by the gutters and run to the water-tight concrete manure pit. (To shape the gutter, make a mold or templet by rounding the corners on the flat side of a 6-foot length of 4 by 6-inch timber.) A gentle slope, toward the low corner, of 1/8 to 1/4 of an inch for each foot of length or width is sufficient. This is secured by the use of a heavy grade stake at each corner of the floor, a straight-edge or a grade line, and a spirit level.

It is an advantage to have a feeding floor its full thickness above ground. Make light floors 4 inches and floors subject to heavy loads 6 inches thick. For the forms use 2-inch lumber of a width equal to the floor thickness. Begin on a low side of the floor. Mark the grade height of each corner stake and set the forms to a grade cord stretched from stake to stake. Use only good materials and mix the concrete 1 part Portland cement to 2½ parts sand to 5 parts screened gravel or crushed rock, or 1 part Portland cement to 5 parts bank-run gravel. Measure the materials exactly; count 1 sack of cement equal to 1 cubic foot.

Always begin placing the concrete on the low side of the floor, so that the rain from sudden showers will not run from the hard onto the newly placed concrete. Fill the trench and the slab section of the forms with concrete. Bring the surface to grade by drawing over it a straight edge with its ends on the opposite forms or with one end on the form and the other on the finished concrete. Four inches in from the edge, on each of the low sides, temporarily imbed the rounded 4 by 6-inch gutter mold and tamp it down until its square top is even with the surface of the slab section of the floor. Remove the mold and finish the surface with a wooden float. The day after the concrete in each section is placed, carefully throw on a covering of hay or straw, and keep it thoroughly wet for a week. Connect the gutters with the manure pit by means of a trough, another gutter, or by large drain tile laid underground. If concrete feeding troughs and racks are to be built at some future time, make the necessary mortises by temporarily imbedding beveled blocks or wooden frames in the soft concrete.

Below is given an itemized bill of materials necessary for a 6-inch floor 24 by 36 feet, amply large to accommodate 50 hogs.

Crushed rock or screened gravel, 20 cubic yards, at $1.10	$ 22.00
Sand, 10 cubic yards, at $1	10.00
Portland cement, 28 barrels, at $2.50	70.00
	$102.00

Mixing the concrete by hand, 5 men can usually finish this floor in two days. Prices of materials vary greatly in different localities. The figures given above are safe; but, before deciding as to what your own floor will cost you, consult local dealers. Depending upon price of labor and materials and the thickness of the concrete, the floor will cost 6 to 12 cents for each square foot of surface.

Concrete Barnyards.

The advantages of concrete feeding floors so appealed to the farmers who first built them that they enlarged the floors until their entire barnyards were surfaced with concrete.

It is no uncommon sight in the spring and winter to see an earthen barn lot so deep with mud that animals go thirsty rather than attempt a trip to the water trough.

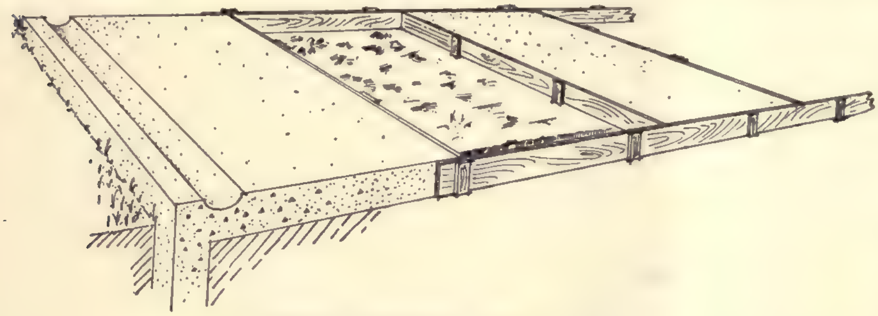
The effect is bad on all kinds of livestock, especially on fattening animals and dairy cattle. "Feeders" must have an abundance of water to fatten quickly. Insufficient water cuts down the quantity of milk given by dairy cows. Lack of enough exercise further decreases the yield. An occasional trip through this mud to the trough so cakes the cows' udders with dirt that the milker wastes valuable time in washing them—and they must be washed, if one would have clean, wholesome milk. Continual tracking through the mud not only makes more currying, but often produces that irritation on horses' legs known as "scratches." Suddenly frozen, such an earthen lot is so rough that it is impassable. Moreover, the old barnyard—with its surface worked up year after year—becomes a storage place, which carries over the disease germs from one season to another. The "droppings" are entirely lost, and, mixed with the earth, tend to make the lot muddier the following year. To keep up the fertility of the soil, all the manure produced on a farm should be saved and returned to the fields.

A concrete barnyard makes a fine exercise lot in all kinds of weather and always affords a dry spot for the animal's bed. Every shower washes the surface clean and flushes the droppings into the manure pits. Concrete yards lighten the work of the housewife, as there is no mud to be tracked on the walks and kitchen floor. The

use of rubber boots is unnecessary. On concrete floors not a particle of grain need be wasted. The way to the water trough is always dry, smooth and passable. Concrete floors promote and protect the health of farm animals and increase the profits of farming, stock raising and dairying.

Construction.

The construction of concrete barnyards is exactly like that of feeding floors, except that the work is on a larger



Cut Showing Perspective View of Floor.

scale. Often the entire lot is not paved in one season, but from year to year as the farmer has time. In excavating for the drainage foundation, be careful to remove all manure and straw which may be tramped into the ground and which may be so solid as to resemble earth. In time any kind of manure decays, shrinks, causes the floor to settle and forms water and ice pockets on its surface. Dig the trench for the foundation apron as for feeding floors—there is no material so rat-proof as concrete.

With the drainage foundation ready, set the forms in the same manner as for a sidewalk. Even if the whole lot is not to be paved at one time, plan the grading for the entire barnyard so that the completed pavement may have perfect surface drainage. Built and cure the pavement and make provision for saving the manure the same as for concrete feeding floors. Do not be too particular about giving the surface a smooth finish—a rougher finish affords the animals a better footing. The cost per square foot is no more than that of feeding floors—the investment yields even a greater profit.

Cut Showing Dairy Cows on Cement Floor.

RECLAMATION PROJECT IN THE STATE OF WASHINGTON.

MOSES LAKE Project

David T. Ham, president of the firm of Ham, Yearsley & Ryrie, of Spokane, announces that $2,000,000 will be expended this year in reclaiming 50,000 acres of land in Grant County, Wash., by using the water of Moses lake. The firm is to carry on the preliminary work in the interests of a central western syndicate, and it is given out that actual construction will begin in 90 days, or as soon as title to some of the land included in the project is cleared. Mr. Ham said:

"We have been working on the plan for two years. We plan the construction of a dam at the south end of Moses lake 20 feet high and 300 feet long. This dam will save 100,000 acre-feet of water. We are planning to construct 13 miles of flume. This work will take a year.

"We are not at liberty at this time to disclose our principals, but they are connected with the strongest financial institutions in the middle west, and are fully able to carry out every enterprise they undertake."

THE METHOW VALLEY PROJECT.

Sixty thousand acres of fruit lands along the Columbia and Okanogan rivers, in north central Washington, will be put under the ditch by the Methow Valley Irrigation Company, incorporated under the laws of Washington with a capital of $1,500,000. Water for this purpose will be taken from the Methow river. Water rights and options on thousands of acres have already been obtained. Work will begin in April.

John M. Ellingsworth, president of the new company, was at one time an attorney for the Union Pacific Railway Company, and went to the Northwest from Omaha. Charles T. Borg is secretary of the company, and Pateros, Wash., is the principal place of business. It is announced by Mr. Ellingsworth that water will be delivered on the land early in 1912.

A DAM ON THE CARSON RIVER.

The Secretary of the Interior has authorized the Reclamation Service to construct by force account a large dam on the Carson river, for storage purposes in connection with the Truckee-Carson irrigation project, Nevada. The Service has accordingly commenced the assembling of the necessary plant and equipment for the prosecution of the work. In this connection contract has been awarded the Marion Steam Shovel Company of San Francisco, California, for furnishing two 1¼-yard steam shovels at a total price of $13,400.

Upon the completion of this dam a large acreage will be thrown open to homestead entry under the terms of the Reclamation Act.

IRRIGATION LANDS OPEN TO HOMESTEAD ENTRY.

The Secretary of the Interior has issued a public notice to the effect that the lands in the Fourth Unit of the Umatilla irrigation project, Oregon, will be open to homestead entry on and after March 22, 1911, and that water will be furnished to these lands during the coming season. Water right applications may also be made for lands within this unit heretofore entered and for lands in private ownership.

The lands in the Fourth Unit lie in Townships 4 and 5 North, Range 28 East, and Township 5 North, Range 29 East, Williamette Meridian. The unit contains 6,053 acres of irrigable land of which 2,763 acres are public land. The building charge, $60 per acre, is payable in not more than ten annual installments, each payment not less than $6 per acre or some multiple thereof, except that in the case of lands hereafter entered the first installment of the building charge shall be $12 per acre, and subsequent installments $6 per acre. All entries must be accompanied by application for water right and by the first installment of the building charge, and one year's operation and maintenance charge, a total of $13.30 per acre of irrigable land, except where payments have been duly made by the prior application and credits duly assigned in writing.

THE PRIMER OF HYDRAULICS*

By FREDERICK A. SMITH, C. E.

7. *Solution of Triangles.*

In Figure 39 let ABC be any triangle the length of the sides being a, b and c respectively and the angles being α, β and γ respectively the following relations obtain:

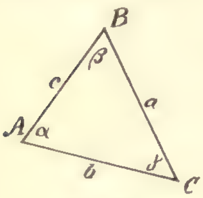


Fig. 39.

$a : b : c = \sin \alpha : \sin \beta : \sin \gamma$; this means that in any triangle any two sides are to each other as the sines of the opposite angles. This rule is used to compute triangles when one side and two angles are given or when two sides and one opposite angle are given.

If two sides and the enclosed angle are given then the following formula is used:

$$a + b : a - b = \text{tg}\,\frac{\alpha + \beta}{2} : \text{tg}\,\frac{\alpha - \beta}{2}.$$

This means: the sum of two sides in a triangle is to its difference as the tangent of ½ the sum of the opposite angles is to the tangent of half the difference of the opposite angles. This is the second general formula.

The third general formula is expressed thus:

$$\text{Cos } a = \frac{c^2 + b^2 - a^2}{2\,bc}$$

which means the cosinus of any angle is found by adding the squares of the two enclosing sides, subtract the square of the opposite side and divide by twice the product of the enclosing sides.

Problem 1. In Figure 39 let $a = 8$ ft., $b = 11$ ft and $\beta = 70°$. Find the side c and angles α and γ.

Solution. $a : b = \sin \alpha : \sin \beta$;

$b \sin \alpha = a \sin \beta$ and

$\sin \alpha = a \sin \beta / b$

Substitute the given quantities:

$\text{Sin } \alpha = 8 \times .9511 \div 11 = .6917.$

The angle corresponding to the sine .6917 in the tables is 43° 46′.

The angle $\gamma = 180 - \alpha - \beta = 180° - 72° - 43°\ 46' = 64°\ 14'$.

The side c is found as follows:

$c : b = \sin \gamma : \sin \beta$.

$c = b \sin \gamma / \sin \beta$; substitute known quantities:

$c = 11 \times .9006 \div .9511 = 10.416$ ft.

Problem 2. In triangle ABC, Fig. 39, side $a = 8$ ft, $b = 11$ ft. and angle $\gamma = 64°\ 14'$; find α, β and c.

Solution. $a + b : a - b = \text{tg}\,\frac{\alpha + \beta}{2} : \text{tg}\,\frac{\alpha - \beta}{2}$

the unknown term is $\text{tg}\,\frac{\alpha - \beta}{2}$; form the product of the means and extremes:

$(a + b)\,(\text{tg}\,\frac{\alpha - \beta}{2}) = (a - b)\,(\text{tg}\,\frac{\alpha + \beta}{2})$; hence:

$\text{tg}\,(\frac{\alpha - \beta}{2}) = (a - b)\,(\text{tg}\,\frac{\alpha - \beta}{2})\,/\,(a + b)$;

Substitute the known quantities and remember if γ is subtracted from 180 it leaves $\alpha + \beta$:

$180 - 64°\ 14' = 115°\ 46' = \alpha + \beta$; then divide 115° 46′ by $2 = 57°\ 53' = \frac{\alpha + \beta}{2}$, also since $b = 11$ and $a = 8$, angle β will be larger than angle α and the formula should be modified as follows:

$$\text{tg}\,(\frac{\beta - \alpha}{2}) = (b - a)\,(\text{tg}\,\frac{\beta - \alpha}{2})\,/\,(b + a)$$

Hence: $\text{tg}\,(\frac{\beta - \alpha}{2}) = (11 - 8)\,(1.5931)\,/\,(11 + 8)$

$\text{tg}\,(\frac{\beta - \alpha}{2}) = 3 \times 1.5931 \div 19 = .2515.$

The angle corresponding to this tangent is found in the table of tangents to be: 14° 7′, thus:

$\frac{\beta + \alpha}{2} = 57°\ 53'$; then $\beta + \alpha = 115°\ 46'$

$\frac{\beta - \alpha}{2} = 14°\ 7'$ $\quad \beta - \alpha = 28°\ 14'$

Add the two values together:

$2\,\beta = 114°$ or $\beta = 72°$;

then subtract $\beta - \alpha$ from $\beta + \alpha$:

$2\,\alpha = 87°\ 32'$ or $\alpha = 43°\ 46'$.

It will be seen if the 3 angles are added together the result is exactly 180°, which proves that the work is correct.

Problem 3. The 3 sides in a triangle are 28, 31 and 42 ft., find the 3 angles.

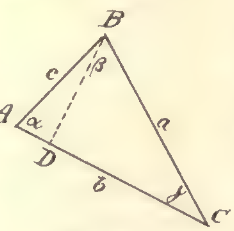


Fig. 40.

Solution. In Fig. 40 let $a = 28$ ft., $b = 31$ and $c = 42$ ft., then by using the third general formula we have:

$\cos \alpha = 31\text{x}31 + 42\text{x}42 - 28\text{x}28 \div 2\text{x}31\text{x}42$

$\text{Cos } \alpha = 1641 \div 2604 = .63031$ look in cosine table which gives the corresponding angles 50° 56′.

to find angle β use same rule:

$\cos \beta = 28\text{x}28 + 42\text{x}42 - 31\text{x}31 \div 2\text{x}28\text{x}42$

$\cos \beta = 2548 \div 4704 = .5417$

look for angle β in cosine table, 57° 12′

then angle $\gamma = 180 - (50°\ 56' + 57°\ 12') = 180 - 108°\ 8' = 71°\ 52'$.

Article V. Mensuration of Plane Figures.

Under mensuration is meant the determining of the areas of surfaces and the solid contents of bodies occupying space. In preceding articles reference has been made repeatedly to methods of finding the area of triangles, rectangles, etc. In the following are shown rules and application for the computing of areas of the more important geometrical surfaces.

1. *Triangles.* The area of a triangle is found by multiplying base by height and divide by 2. (See Art. 3.) When the 3 sides of a triangle are given, when a, b and c are the 3 sides and $S = ½$ their sum, the area is found as follows: $\Delta = \sqrt{s\,(s - a)\,(s - b)\,(s - c)}$. To apply this formula let $a = 16$ ft., $b = 17$ ft., $c = 13$ ft., then $S = \frac{16 + 11 + 13}{2} = \frac{46}{2} = 23$. Substitute values in formula:

$$\text{Area} = \sqrt{23\,(23 - 16)\,(23 - 17)\,(23 - 13)}$$
$$= \sqrt{23\text{x}7\text{x}6\text{x}10} = \sqrt{9660} = 9.828 \text{ sq. ft.}$$

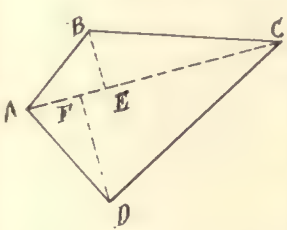


Fig. 41.

2. *Quadrilaterals.* The area of a rectangle, square, rhombus and parallelogram is found by multiplying base by height. The area of a trapez is found by cutting it into 2 triangles, finding the area of each of the triangles and adding them. Then in Fig. 41 the area of trapez $ABCD$ is found by drawing AC, which divides the figure into two triangles and serves as a common base for both triangles; draw BE perpendicular to AC and DF perpendicular to AC, then area of triangle $ABC = \frac{AC \times BE}{2}$, and area of triangle $ACD = \frac{AC \times DE}{2}$, hence area of $ABCD =$

$$\frac{AC \times BE}{2} + \frac{AC \times DE}{2} = \frac{AC}{2}\,(BE + FD.)$$

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3. *Polygons.* This principle may be extended to any polygon; thus for instance the 7-sided figure shown in Fig. 42

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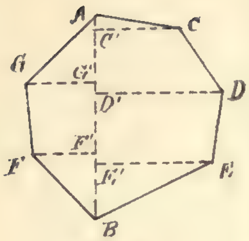

Fig. 42.

can be cut into 5 triangles by diagonals and the area of the figure will be the sum of the triangles. Another method can be used, indicated by dotted lines where the figure appears cut into 4 triangles and 3 trapezoids, all right angled. The advantage of the latter method is that the line AB serves as height for all the figures, and if the dimensions CC', DD', EE', FF', GG', and the dimensions on AB as AC', $C'D'$, $D'E'$, $E'B$, BF', $F'G'$ and $G'A$ are either given or observed, the area of the polygon $= \frac{CC' \times AC'}{2} + \frac{CC'+DD'}{2} \times C'D' \times \frac{DD'+EE'}{2} \times D'E' + \frac{EE' \times BE'}{2} + \frac{BF' \times FF'}{2} + \frac{FF'+GG'}{2} \times F'G' + \frac{AG' \times GG'}{2}$; this can be simplified as follows:

Area $= \frac{1}{2} [CC' \times AC' + C'D' (CC' + DD') + D'E' (DD' + EE') + BE' \times E'E + BF' \times FF' + F'G' (FF' + GG') + AG' \times GG'.]$

4. *Regular Polygons.* A regular polygon is a figure in which all the sides and all the angles are equal. The area of a regular polygon is easily found by cutting the same into triangles from the center point. Thus in Fig. 43 the regular heptagon is divided into 7 equal triangles by connecting the corners to the center O; then each central angle $= \frac{360}{7} = 51° \ 25' \ 43''$.

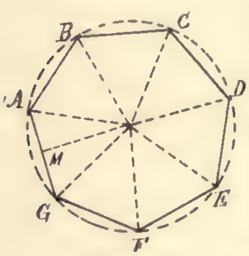

Fig. 43.

Draw OM perpendicular to AG; this bisects central angle so angle $AOM = 25° \ 42' \ 51.5'' =$ say $25° \ 43'$; let the side $AG = 12$ ft., then $AM = 6$ ft.; let $OM = h$ then $\frac{h}{6} =$ cotg $25° \ 43'$, and $h = 6$ cotg $25° \ 43' = 6 \times 2.0763 = 12.4578$ ft.; area of triangle $AOG = 6 \times 12.4578 = 74.7468$ sq. ft., and area of heptagon $= 7 \times 74.7468 = 523.2276$ sq. ft.

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5. *The Circle.* The circumference of a circle is 3.1416 times the diameter or, if r is the radius 2π r. If the circle is considered a polygon with a very large number of sides, and the ends of these sides all connected to the center O, see Fig. 44, then the circle is cut up into a large number of equal triangles, all having the same height, which is the radius, and the sum of the base lines making the circle line, if the bases of triangle $= a$ the area of circle $= \frac{ar}{2} + \frac{ar}{2} + \frac{ar}{2} + \ldots$ in which the factor $\frac{r}{2}$ may be set out; thus: $A = \frac{r}{2} (a + a + a + \ldots .)$ but the sum $a + a + a + \ldots . =$ circumference $= 2 \pi r$, hence by substitution we get:

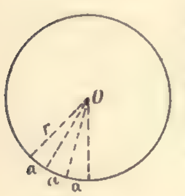


Fig. 44.

$A = \frac{r}{2} (2 \pi r)$; this can be simplified to: $A = \pi r^2$ which, expressed in words means: The area of a circle is equal to the square of the radius multiplied by 3.1416.

(Continued on page 869.)

Supreme Court Decisions

Irrigation Cases

PERCOLATING WATERS—

Injunction lies where one by means of a well in the highway wrongfully diverts percolating water from an abutting owner of the fee. *Bonetti* v. *Ruiz*. Court of Appeal, Second District, California. 113 Pacific 118.

SUIT BY LOWER PROPRIETOR—

Where a lower riparian proprietor diverts on his own land only such water as the upper proprietor permits to flow down to him, the nonuser of water by the upper proprietor is not available to strengthen a claim of appropriation by the lower riparian proprietor by prescription. *Perry* v. *Calkins*. Supreme Court of California. 113 Pacific 136.

WATEB RIGHTS—

A reservation in a grant of land for an irrigation ditch of the right to use water therefrom, to the extent of grantors' "interest," etnitled the grantors to flow through the ditch and to divert therefrom on land retained a quantity of water represented by stock in a water supply company, but the amount could not be increased by subsequent purchase of other stock. *Ruhnke* v. *Aubert*. Supreme Court of Oregon. 113 Pacific 38.

RESERVOIR SITES—

Filing upon a reservoir site by a company and subsequent approval thereof by the Secretary of the Interior, whether valid or voidable, segregated the land from the public domain for private use, so that no legal entry of it could be made by another before a judicial, legislative, or executive determination restoring the site to the public demand. *O'Reilly* v. *Noxon*. Supreme Court of Colorado. 113 Pacific 486.

DAMAGE BY FLOW—

Where water, wrongfully collected and discharged by defendant, flowed down and spread over plaintiff's field sown to grain and actually damaged him, there was an invasion of plaintiff's property rights, authorizing the recovery of nominal damages and the granting of an injunction, and evidence of any specific amount of damage was unnecessary. *Galbreath* v. *Hopkins*. Supreme Court of California. 113 Pacific 174.

PRESCRIPTIVE RIGHT—

No right to water in a stream can be acquired by prescription, where the lower riparian proprietor has taken the water out of the stream at a point on his own land, and uses only such water as the upper riparian proprietor has permitted to pass down to the lower owner; such use not being adverse in the sense required to give a right by prescription. *Perry* v. *Calkins*. Supreme Court of California. 113 Pacific 136.

DEED AND WATER RIGHT—

A deed of land by one having the right to divert water as a stockholder in a water supply company, including 28⅔ "inches of water stock," gave the grantee the right to divert 28⅔ inches of water from a ditch from which the grantor had a right to take water as an easement appurtenant to land, including that conveyed, and gave the grantee the right to use such water anywhere on his land. *Ruhnke* v. *Aubert*. Supreme Court of Oregon. 113 Pacific 38.

HEAD GATE—

Where a ditch having priority had appliances for diverting water from the river, the character of such appliances is only material on the question of the volume of water diverted through the ditch, and where there was ample testimony to show the amount of water diverted, the mere absence of such a head gate as the statute requires does not affect the rights of the parties in an action for diverting water and settling rights. *Johnson* v. *Sterling Irr. Co.* Supreme Court of Colorado. 113 Pacific 496.

INDEPENDENT USE OF INCREASED FLOW—

If defendant Irrigation Company had, by turning additional streams into its canal or by some form of work, prevented loss by seepage, evaporation, or the like, and thereby increased its natural flow, it might claim the additional waters as salvage, and not within prior irrigation con-

(Continued on page 873.)

ARID AGRICULTURE

BY

B. C. BUFFUM, M. S.

Manager of the Wyoming Plant and Seed Breeding Company, Worland. Former Professor of Agriculture in the University of Wyoming and the Colorado Agricultural College, and Director of the Wyoming Agricultural Experiment Station.

Prof. B. C. Buffum.

The Sugar Beet and Its Culture.

The luxuries of yesterday become the necessities of tomorrow. The main business of the farmer is to supply the world's necessities.

Beets a Direct Food.

Sugar beets may be grown for two general purposes; first, as a direct food for stock and man; second, for the manufacture of sugar. Beets have been grown many years for stock feed, but the sugar beet for manufacture become a new crop, where factories are established.

The value of the beet as a supplementary food for stock is something we have been slow to learn. Even after the sugar has been extracted, what remains is worth enough for food to make the by-products valuable.

Special Culture Required.

Where beets are properly raised for the production of sugar, their culture differs at almost every point from the culture of alfalfa, wheat and potatoes, which have been our staple crops.

The high sugar content and purity of the sugar beet are artificial characteristics produced by years of special cultivation, selection and plant breeding. This has given rise to "kinks" in beet culture, which are not only important but essential if we make the value of the crop sufficient to meet the expense of producing it and provide a profit.

Beet Growing Intensive.

Raising sugar beets is intensive farming. They cannot be successfully produced except by intensive methods. On this account sugar beet culture introduced in a community which has generally practiced extensive cropping, means learning something new. The farmer must put aside the idea that his experience with other crops will enable him to grow sugar beets successfully. He must follow the experience of those who have long practiced beet culture if he hopes for success.

The German who said that the Americans could not grow sugar beets because they would not get down on their knees to hoe, has given us some idea of the essential difference between beet culture and the culture of our ordinary crops. While there is a right method of beet culture, undoubtedly general practice may be somewhat modified by the peculiar conditions of each locality. Experience in other places is valuable, but not always infallible.

Adapting Crops Important.

We have much to gain by creating races and varieties of plants which will be fully at home and adapted to our soil, climate and system of irrigation. It has taken long years of careful breeding and cultivation to produce the sugar beet of today. The amount of sugar it contains has been quadrupled and other solids eliminated until it has great purity. At the same time the beet has taken on desirable shape and size. To grow them properly the farmer must carefully, honestly and persistently follow out rules of beet culture, perhaps with some intelligent modification.

It will probably take thoughtful farmers three years to learn to grow beets. You may make a good profit before you learn how to grow the beets, but your profit will not be as large as after a little experience.

Average Crops Not Profitable.

An average crop of anything is not highly profitable. The man who gets only an average crop should be well satisfied if he makes expenses, and should rejoice over an additional 3 per cent gain on his investment. The average crop of potatoes for the United States is about 64 bushels per acre, say 38 sacks. In our best potato districts under irrigation the cost of raising an acre of potatoes is about $30. There are not many farmers in the West who would go into their fields rejoicing, to harvest less than 38 sacks of potatoes per acre.

If the crop of sugar beets averages only 10 tons per acre, worth an average of $4.50 per ton, there may or may not be a cash profit in raising them. It will depend on whether it has cost $30 or $50 to grow and market the beets. Good farmers in beet-raising sections will probably produce more than twenty tons and possibly twice that in some cases with little increase in the cost. Where this occurs they will bring magnificent profits and boom the bank account.

The main idea is, of course, the immediate money value of the crop. While this part of the reward will, undoubtedly, be highly pleasing to the man who properly grows his beets, it is not the only thing to be gained from beet farming.

Beets and Prosperity.

Where sugar beets are grown for a factory, producing them, more than the raising of almost any other crop, brings prosperity to a community. This is not due alone to the money reward to the grower. There are several ways in which growing beets differ from the growing of other crops in the ultimate result to our agriculture.

Money Put Into Circulation.

First—The more money handled in a way which puts it into wide circulation, in any business, the greater is the commercial and social activity. This is the reason that manufacturing and trade centers are prosperous. Growing beets requires intensive cultivation. If a farmer raises 10 acres of sugar beets as they should be managed, it means the expenditure of $300 to $500, much of which is paid for labor. In a beet-growing community everyone is employed, everyone has some money to spend, and real estate, the merchant, the barber, the church and the school respond to the magic. The establishment of successful factories has always resulted in improved conditions.

Something to Be Learned.

Second—There is an important educational feature about growing beets. The farmer who raises them learns something new about agriculture. Some of the underlying principles of his high calling are forcibly brought to mind. He has known in a general way that plants are sensitive to conditions of soil and climate. He has read Mark Twain's way of putting it, when he makes Puddin' Head Wilson say: "Training is everything; the peach was once a bitter almond, and the cauliflower is nothing but cabbage with a college education."

He is now becoming acquainted with a sugar beet which was once an annual weed growing on the seacoast, and the things he learns are too numerous to mention.

Profit From Smaller Areas.

The bringing of some of this land under intensive cultivation to gain larger profits from smaller areas is a most important lesson for the irrigation farmer. We will have more people, more happiness and more general prosperity when we have fully reached the realization that more of everything we work for can be obtained from an irrigated farm of twenty acres properly managed than from an hundred or a thousand acres which keeps a man both skin poor and penniless. This is one of the last and hardest lessons the arid land farmer, who comes from regions where the more land the more wealth principle prevails, has to learn.

(To be continued)

BORAX IN THE UNITED STATES.

California produces all the borax mined in the United States and is now supplying nearly all the domestic demand. The principal mine is in the Death Valley region, in Inyo County. Another mine is in Los Angeles County.

The mineral mined is colemanite, or borate of lime, most of which is shipped crude to Alameda, Cal., or Bayonne, N. J., for refining.

INTERSTATE WATER RIGHTS.

By G. N. Houston, C. E.

One of the most important questions affecting Colorado today is the matter of interstate water rights. This state is in a very enviable position with regard to water. Practically all the streams in the state rise within its borders and the question naturally presents itself, has Colorado the right to use all these waters without regard to the adjoining states? We have assumed that we have and have proceeded to appropriate all we could get sometimes, as in the case of the Arkansas river, leaving nothing for the people of Kansas. This gave rise to the famous Kansas-Colorado case which was decided in 1907 by the Supreme Court of the United States.

The state of Kansas sued the state of Colorado, claiming that the people of this state had appropriated and used all the waters of the Arkansas river, thereby damaging the state of Kansas.

I will quote a paragraph from the conclusion which gives a very concise statement of the opinion of the court.

Summing up our conclusions, "We are of the opinion that the appropriation of the waters of the Arkansas by Colorado for purposes of irrigations, has diminished the flow of water into the state of Kansas; that the result of that appropriation has been the reclamation of large areas in Colorado, transforming thousands of acres into fertile fields and rendering possible their occupation and cultivation when otherwise they would have continued barren and unoccupied; that while the influence of such diminution has been of perceptible injury to portions of the Arkansas valley in Kansas, particularly those portions closest to the Colorado line, yet to the great body of the valley it has worked little, if any, detriment, and regarding the interests of both states and the right of each to receive benefit through irrigation, and in any other manner from the waters of this stream, we are not satisfied that Kansas has made out a case entitling it to a decree. At the same time it is obvious that if the depletion of the waters of the river by Colorado continues to increase, there will come a time when Kansas may justly say that there is no longer an equitable division of benefits, and may rightfully call for relief against the action of Colorado, its corporations and citizens in appropriating the waters of the Arkansas for irrigation purposes.

The decree which, therefor, will be entered, will be one dismissing the petition of the intervenor, without prejudice to the rights of the United States to take such action as it shall deem necessary to preserve or improve the navigability of the Arkansas river. The decree will also dismiss the bill of the state of Kansas as against all the defendants, without prejudice to the right of the plaintiff to institute new proceedings whenever it shall appear that through a material increase in the depletion of the waters of the Arkansas by Colorado, its corporations or citizens, the substantial interests of Kansas are being injured to the extent of destroying the equitable apportionment of benefits between the two states resulting from the flow of the river. Each party will pay its own costs."

The last portion of this paragraph is especially interesting as the United States Irrigation Company, a Kansas corporation, has recently started an action against certain Colorado irrigation companies in the Arkansas valley, claiming that they have a prior right to certain waters of the Arkansas.

This involves the broad question of whether priority of appropriation is to apply to the whole stream from source to mouth regardless of state lines, or whether the people of this state, for instance, can appropriate and use all the water to the exclusion of prior appropriations in states further down the river.

To the person not familiar with the use and distribution of water this may seem to be a very simple matter, and if he has no personal interests at stake he will be apt to decide in favor of priority of right on the whole stream. There is, however, another phase of the question, that of maximum beneficial use.

Suppose this case, for instance: A. B, C and D have equal appropriation in the order given. A's appropriation is earlier than B, C, or D's, but he is located several miles below them on the stream. Assume that the bed of the stream is sandy, such as is commonly found on the plains. There is sufficient water passing D's headgate to supply three out of four of these rights, but in order to carry A's appropriation down to him we are obliged to run three times his appropriation past B, C and D. That is, we waste twice as much water as we put to beneficial use. Many water commissions in this state have faced a similar problem.

Where there are reservoirs this can be solved by an exchange of reservoir water further down and nearer A, for the water in the stream near B, C and D. Where no exchanges of this kind can be made the law of prior appropriation requires A to be furnished first, but it would seem that the interest of the public in general would be better served by a more economical use of the water. This matter of interstate water rights has come up between Wyoming and this state in connection with the appropriation on the Larimer river made by the Greeley Poudre Irrigation district.

Also on the Rio Grande river in connection with the Engle dam project of the reclamation service in New Mexico, which was discussed in the daily papers and at the irrigation congress held at Pueblo recently. This is only the beginning of the trouble as the question will ultimately arise between this state and all adjoining states. I would suggest that matters of this kind could be settled far more satisfactorily and with less cost to the states concerned by a commission appointed by each state to be known as the interstate water commission, of the states appointing the same. If the states of Wyoming, Nebraska, Kansas, New Mexico, Utah and Arizona would appoint commissions of this kind, questions of an interstate nature could be settled by a conference between the commissions of the states involved. The state engineer of each state should be ex-officio member of the commission, and the other members appointed one from each of the larger irrigation divisions.

In conclusion I would say that while Colorado started on its career as a mining state and has risen to its present importance on that foundation, it does today and will henceforth depend upon irrigated agriculture for its maintenance and further development.

IRRIGATION PROJECTS UNDER WAY.

Construction work has been started at White Bluffs, Wash., on a project designed to irrigate 75,000 acres of land in the Columbia River Valley. Water will be supplied by the Pacific Power & Light Company, which operates a hydroelectric plant on the Columbia river near Priest Rapids. The company also is extending its high-tension lines from Priest Rapids to Hanford, Wahluke, Kennewick, Pasco, Mattawa, Moses Lake and Ephrata, Wash., to supply power for irrigation purposes. E. Campbell, president of the Mattawa Power and Irrigation Company, says 100,000 acres of land in the Priest River Valley is being put under ditches by the development of water power of the rapids.

United States Senator Jones says in a letter to H. M. Gilbert of Toppenish, Wash., that every possible effort will be made to secure action toward building the reservoirs at the headwaters of the Yakima river in central Washington, so that if the government does not undertake the building of the canals there will be ample supply for projects, the water to be sold to corporations under the Warren bill.

Colonel Adebert M. Dewey of Spokane, head of the Okanogan Irrigation and Improvement Company, announces that work on fifty miles of canals and ditches on his project on Whitestone flat and Horsespring coulee in Okanogan county, Wash., will begin early in April with a view to completing it in November. Sixty men and teams will be employed. Three options are offered: Each man to take his work out in money, land or stock. None will receive anything until the end of the seven months. At the end of the seven months a single man will have $700 to his credit, which he can take in cash, or apply it on the land, or take it out in stock in the company. A man and a team will earn $1,300.

Hanford Irrigation & Power Company is rushing work at several points near Hanford, Wash. One hundred men and twenty-five teams are at work at Priest Rapids, where the improvements at the pumping station at Coyote will be completed early in April. One hundred and seventy-five men are at work on the irrigation canal cleaning and cementing it in time for the spring irrigation season.

THE WILLISTON, NORTH DAKOTA, IRRIGATION PROJECT.

The Secretary of the Interior has issued the following order for the purpose of relieving the present situation on the Williston irrigation project, North Dakota, pending the issue of public notice modifying or abrogating the notices heretofore issued:

(a) A stay of proceedings looking to the cancellation of entries or water-right applications because of failure to make payment will become effective as to all water-right applications subject to public notices heretofore issued upon the payment of $1.50 per acre on or before March 31, 1911, for operation and maintenance, subject, however, to compliance with the conditions of a public notice to be hereafter issued, which will provide for an increased building charge. Before the delivery of any water, an additional payment must be made at the rate of $1.00 per acre-foot for operation and maintenance for all water delivered, payable in advance as deliveries are requested. Such stay of proceedings shall remain in effect until further announcement by means of a public notice or otherwise. (b) Water will also be furnished in the year 1911 to others upon the filing with the project engineer of proper applications subject to the terms of this order and to the payments and conditions herein provided. No water will be furnished in any case unless the holdings of the applicant for water shall have been conformed to the farm unit shown on the approved farm unit plats.

Upon failure to make payments as herein required on or before March 31, 1911, the entry or water-right application, or both as the case may be, which would otherwise be subject to cancellation, will be promptly canceled without further notice.

The pumping barge will not be launched in 1911 until the aggregate payments made to the United States for operation and maintenance for 1911 amount to $9,000. The operation of the pumps will be planned with a view to an approximately uniform rate of delivery of water and for adequate irrigation in the shortest practicable operating period.

All applications for water-rights filed under the provisions of the notices heretofore issued and for which the payment necessary to avoid cancellation shall have been made on or before March 31, 1911, shall be continued in effect under such prior notices; and water-right applications may be filed on or before March 31, 1911, under the provisions of the public notices heretofore issued if accompanied by the payment required thereunder, and shall be entitled to continue under the terms thereof.

The intent of this order is to permit all persons who so desire to obtain the benefit of the former building charge of $38.00 per acre by making the necessary payments on or before March 31, 1911, or by filing new water-right applications accompanied by the necessary payments on or before that date; and that all other persons under the project who desire to be furnished with a water supply shall pay the sums herein specified and be subject to the conditions of such public notice as may be hereafter issued.

This shows a ditch dug by the Avery Traction Steam Shovel. It is claimed for the outfit which performed this work that it is more than a steam shovel, in other words it is a traction engine combined with the shovel. The same engine may be used by a rancher on a combined cultivator, for hauling, plowing, belt-work, traction work, grading, driving stone crusher and pulling road grader. This engine is made by the Avery Company, Peoria, Ill.

CORRESPONDENCE

THE EXPERIENCE OF A COLLEGE PROFESSOR ON AN IRRIGATED RANCH

*By Montgomery Moore, A. M., Ph. D.

The first trip across the ocean, usually brings out all there is in a man. During his mal-de-mer (sea sickness), he consigns everything to the briny deep. He is at war with himself and his more fortunate neighbors and disgusted with everything animate and inanimate.

Old ocean, with her gray waste and the majesty of her angry waves, when stirred to violence, during a storm, has no effect upon his imagination.

Similar feelings arose within me, when I just pitched my tent upon the desert of Gebbi Heights.

True it is, that I was surrounded by the beauties and grandeur of nature. The heaven above me, was a panorama of shifting forms and colors, vanishing in a moment, only to reappear with added beauty.

The landscape was as changeable as the clouds, sailing through the aerial ether. The undulating hills and valleys lying between, the mountains in the distance, with their seared and rugged heights, all revealed the loveliness and sublimity of the Creator's handiwork.

"Grand and magnificent scenery! Pike's Peak! The life giving ozone! The turquoise sky! the perpetual sunshine! All clothed in purple adjectives, glittered like a diamond upon the outstretched forefinger of time, pointing the way to luxury and a life of ease.

When I first heard these words, I became intoxicated, through the exuberance of my imagination, but I soon became sobered when the real facts presented themselves to me. I realized that I must begin a struggle for existence.

As I did not arrive here until the tenth of June, 1909, the question arose, should I spend the summer in idleness—as was suggested—or attempt to raise something on the land, which had already been plowed, at the cost to me, of $2.50 per acre.

I was minus the three essentials necessary to put in a crop—a team—farm implements and experience.

After scanning closely the printed reports of the agricultural colleges of the state and eminent scientists who had examined the soil and rendered a judgment as to its fertility of the kind of crops to plant, I determined to put in five acres of navy and five acres of Mexican beans.

My neighbor—an experienced farmer—kindly consented to put in the crop for $4.50 a day.

After the beans were planted the rains descended and beat upon them and they, being hard headed, pushed their way through the soil and grew, and grew.

Anxiously I watched their growth and development, with mingled fear and hope.

The wise acres laughed at the venture and predicted a total failure, saying that Jack Frost was lying in wait for my beans. But Jack Frost tempered his severity to the shorn lamb.

During all that summer no word of cheer was given. No helping hand extended but my pathway was ever lined with a row of palms, stretched forth to receive the profit, should there be any, from my experiment.

The next difficulty that confronted me was the purchase of a team and cultivator. I did not care to go into this extensively until I saw my way clear.

Just at this time I discovered that there were many people who were very solicitious about my welfare, and had just the kind of horses I needed.

My father was a great lover of horses and always had in his stables, both thorough and standard bred horses. Hence I was not unaware of the characteristics of good qualities of horses and their proper care and management.

Of my own free will I purchased for $60, a white Mexican pony of unknown age and pedigree, but warranted to be gentle and sound. Today "Billy" as he is known all over this mountain side, through kind treatment and not too hard work, has become a valuable possession.

From early morn till eve, Billie and I cultivated those beans. They were the pride of my heart and I hoped would inflate my pocketbook; and, when the sun was setting behind the western mountain, we could be seen trudging our weary way homeward.

Although I had settled on irrigated land, the down fall of rain was nearly sufficient, so only one irrigation was necessary for the beans.

Having read that "No occupation on earth, equals irrigation for ease of income." I located on "Easy Street." But alas! I found no surcease of labor, and I am still waiting for the "income."

Like the man who when asked why he was spending his summer at Manitou, replied: "For change and rest, but the street cars got the change and the hotels the rest." I have neither change nor rest.

My life, thus far, had been spent within the walls of the school room, acquiring knowledge and training the youth to travel in the orbit of duty.

While I found this a most difficult task, I discovered, in irrigation a much harder problem, i. e., to irrigate properly, sloping land. Water naturally seeks its level and there seemed as many levels on this uneven land as Russian thistles on the newly plowed, uncultivated land.

My previous training, in patience and endurance, was stretched to the utmost, when I first attempted to direct a stream of water, in the way in which I wished it to go, so that it would be distributed evenly over the land.

Were I to tell the story of my first experience, at irrigation, I could truthfully say, with Aneas, "That it would cause the Myrmidans to weep and the hard hearts of the soldiers of Archilles to melt with pity.

But now, I rather enjoy seeing the uninitiated make their first attempt.

A very fine old gentleman, desired to help, when the water was first turned on his sloping land. Soon the water got beyond his control. He tried hard to check it, but it ran streaming down his shovel; in disqust he exclaimed: "To h—— with irrigation, I'm going home and go to bed."

When the beans were matured and ready to be harvested, the question arose, how could this be done? Should they be pulled by hand (a back breaking process), or by machine? To pull by hand was out of the question, so I bought a machine.

Again my neighbor came to my assistance with his mules, this time at $4.00 per day.

I bunched most of the beans myself, but after ten days of this work my muscles refused to obey the mandates of my will and I hired help.

The only unpaid aid I have received here, came at this time from a man and his son from Connecticut. They walked out here, worked all day and would not accept anything for their labor.

When the beans were stacked, no bean thrasher available, they were thrashed with a flail and winnowed by the winds of heaven.

The winter evenings were spent in picking them over by hand.

Being of excellent quality, they readily sold, at seed time, for eight cents a pound.

They brought me sufficient to buy a team and farm implements.

One acre of Kaffir corn was raised for fodder and one acre of millet for the chickens.

Although late, a fine garden was put in and cabbage and tomato plants planted, but the main ditch broke, during a severe rain and washed everything down hill. All summer the valley below blossomed with the flowers we intended should adorn a place nearby. The only thing that withstood the freshet, was a row of mammoth sunflowers, along the ditch. They seemed beautiful, as their heads nodded "good morning" over the water.

For five months we lived in the tent that was pitched the first day we moved on the land.

The early morning hours brought the luxuries of the land of the blessed, but when the mid-day sun streamed down upon the white canvas, all coolness vanished and the heat and glaring light caused us to seek shelter in the meagre shade of the tent.

When the winds blew and the rain came down in torrents the shelter was not so secure and delightful as might be imagined. Those unacquainted with the mountain winds of Colorado, have little idea of their sudden force and violence.

*Professor Moore has a ranch at Fountain, Colo.

It may be a dead calm when suddenly a blast bursts forth, shaking the tent to its foundation and threatening to sweep it across the heights.

Many nights the heavy down pour of rain, penetrated the tent and gave us an unexpected shower bath. Once the wind wrecked the tent and the heavy snow fall, the first of November, made it uninhabitable.

Luckily, in the bungalow, we were building, one room was nearly finished, and in this room we sought shelter, after more than twelve hours, wading in the snow and keeping warm by exercising.

We came not alone to these heights, but brought with us our choicest treasurer, a big tiger cat "Boy" and twenty-five barred and white rocks, scored by a competent judge.

It was a pitiful sight to see these chickens turned loose after a five days journey, with no place to go, no shelter whatever when darkness fell upon them.

With the aid of dry goods boxes and some quilts, we managed to make a place at the side of the tent.

Next day, four posts, a few pieces of scantling and some slabs were converted into a rude house.

My experience, in building was similar to that in farming. My hands were tender and soft, and my strength spasmodic, and of little endurance. The sawing of the boards taxed me to the utmost, and I had fewer finger nails, at the completion of the work, than I had at the beginning. The hammer seemed to me cross-eyed and more often missed than hit the head of the nail, but it seemed to always find a part of my anatomy. Nature was kind to me, and came to my rescue. She first blistered my hands and then made them callous.

Having been accustomed to a market, where what the appetite craved, could be secured, we found that we would have to subsist upon those things which could be readily obtained.

As a cow furnishes half of the living, we purchased one with her calf for $65. To obtain this half of the living, from the cow, was an arduous task. We knew less about the milking of the cow than she did herself, so instead of training her, she trained us, how to do the work.

I tried to milk her and in so doing learned the lesson of aerial navigation and not to cry over spilled milk.

My wife then took her in hand and today she is gentle to milk and comes when called.

My wife seems to have a craze for raising calves, and succeeded in raising seven calves from this cow "Boss" during the first year. This story was told to a man and when he looked incredulous, my wife said : "You do not believe that do you?" and he replied, "Some people would." Well, she raised the cow's own calf and bought six others.

Four were sold for young beef. One heifer was sold to a dairyman. One died from eating damp alfalfa. And the cow still has her own calf "Beauty" which she loves as much now as the day it was born.

Beauty is today a cow valued at $50, at least I refused that amount for her.

This year we sold two calves, for $9.00 each. We sell cream and have plenty of milk for our own use and the chickens and pigs.

The poultry business has grown to such an extent that it requires all the time of one person to manage it. We have never been able to supply the demand for stock and eggs for setting. Only yesterday a man came over from the Springs and offered me $3.00 a piece for all my white rock pullets, but I did not care to sell them.

The only thing that has not come up to my expectation are the pigs. They refuse to attain the mammoth size, I have read they should. An experienced farmer told me it was because their tails were too long and inquired why I did not cut them off? I told him I had read that in order to have healthy pigs, their tails must curl and if I cut them off there would be no curl.

I have fenced the tract, built a good stable, sanitary chicken houses, cement house for the incubators, made a large cistern, and the end is not yet.

Three acres of cherry trees were set out and 100 Carolina poplars planted on dry land around the bungalow.

Such has been my first year of farm life and it consisted chiefly of hard labor.

'Twuz lucky ma was brave, when things wuz goin' wrong.
She never whined, but kept a-hoping right along;
When I was in the dumps, I've often heard her say:
"Its always darkest just before the break of day."
Well she was right, you see; we've nothin' now to dread.
The winters nearly past, and there is light ahead;
I'm so relieved I'd like to jump and crack my heels,
And ma sings all day long to show how good she feels.

The mental life to which I have been accustomed is blotted out. The books, magazines and papers are covered with dust and no longer my daily companions. The social life is a thing of the past. The mantle of Doctor of Philosophy has fallen from my shoulders, like a worn out garment and the dignity which it bore has departed.

I am called "the old man" and for my success in raising beans on virgin soil, often dignified by the sobriquet "the bean man from Fountain."

I have become simply "the man with the hoe and the brother of the ox."

For one year and a half our home has been on Gebbie Heights. The scene has changed somewhat since we first pitched our tent.

Instead of the barren lands and bleak heights, the place is covered with cultivated fields, ornamented trees and orchards and dotted with houses and the necessary farm buildings.

The irrigation system has been vastly improved and there seems a good prospect that in the not far distant future, this place will become a "thing of beauty and a joy forever."

MONTGOMERY MOORE, A. M., PH. D.

AN ENCOURAGING LETTER.

IRRIGATION AGE:

Enclosed please find 10c in stamps. Kindly send me a copy of the last number of IRRIGATION AGE. Mine has been destroyed. The IRRIGATION AGE is one of the few periodicals which are worth keeping.

Yours truly,

J. W. TAYLOR.

This is a very encouraging letter, and the Editor feels that it should grace a corner in the new Correspondence Department. Mr. Taylor is evidently appreciating the IRRIGATION AGE and the Editor will do his best henceforth to make its columns indispensable to its many readers.

March 23, 1911.

EDITOR IRRIGATION AGE:

Will you, as a favor, inform me as you may be able what the law in New York state is relative to appropriating all or part of the water flowing in an unnavigable stream through land of which one is the posessor?

You will oblige, yours very truly,

JOHN W. DE BRUYN.

84 Worcester St., Boston, Mass.

Will some one of our readers give this information to Mr. De Bruyn either directly or through the columns of IRRIGATION AGE?—Editor.

(Continued from page 863.)

6 *Elements of Sectors and Segments.* In Fig. 45 let AB be any chord, draw radii AO and BO and draw OM perpendicular to AB, then $AM = BM$ and arc AC = arc BC. Let r = radius of circle and c = length of chord, then the other elements can be computed. Let $MO = \chi$, then $\chi^2 = r^2 - \left(\frac{c^2}{2}\right)$; or $\chi = \sqrt{r^2 - c^2/4}$.

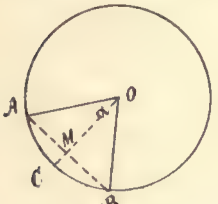


Fig. 45.

χ can also be found without extracting the square root as follows: let angle $AOB = \alpha$, then angle $AOM = \frac{\alpha}{2}$.

$\text{Sin}\ \frac{\alpha}{2} = \frac{c}{r}$ from which angle $\frac{\alpha}{2}$ can be found; then, since $MO \div r = \cos \frac{\alpha}{2}$, $MO = r \cos \frac{\alpha}{2}$.

The area of sector AOB is found as follows: the area of the whole circle $= \pi r^2$; the area of a sector whose central angle $= 1°$ is $\frac{\pi r^2}{360}$, hence if there are α degrees in angle AOB the area of sector $AOB = \frac{\pi r^2 \alpha}{360}$.

The area of segment ABC is found by subtracting triangle AOB from sector AOB, hence segment $ABC = \frac{\pi r^2 \alpha}{360} - \frac{c}{2} r \cos \frac{\alpha}{2}$.

The middle ordinate $CM = r - r \cos \frac{\alpha}{2}$, or by simplifying: $CM = r\left(1 - \cos \frac{\alpha}{2}\right)$.

Applied Problems. In a circle having a radius of 7′ 9″ is drawn a chord 10 ft. long; find central angle, area of sector, area of segment and middle ordinate.

Referring to Fig. 45, call central angle α, then $\sin \frac{\alpha}{2} = 5 \div 7.75 = .64052$; refer to a table of natural sines, this gives $\frac{\alpha}{2} = 39°\ 50'$, hence angle $\alpha = 79°\ 40'$.

$MO = r \cos \frac{\alpha}{2} = 7.75 \times .76791 = 5.95131$ ft.

Then middle ordinate $= 7.75 - 5.95131 = 1.78969$ ft.

Area of sector $= 3.1416 \times 7.75 \times 7.75 \times 79.67 \div 360 = 41.765$ sq. ft.

Area of triangle $AOB = \frac{c}{2} r \cos \frac{\alpha}{2} = 5 \times 5.95131 = 29.76655$ sq. ft.

Area of segment $ACB = 41.765 - 29.767 = 11.998$ sq. ft.

Problem. If in the preceding problem the angle α and radius r are given, then the chord, middle ordinate, arc, area of sector, area of segment can be computed. Let $\alpha = 52°$ and $r = 200$ ft., then angle $AOM = 26°$ and let c = chord; then $\frac{c}{2} \div 200 = \sin 26°$ or $\frac{c}{2} = 200 \times .43837 = 87.674$ ft., hence $c = 175.348$ ft.

$MO = 200 \cos 26° = 200 \times .89879 = 179.758.$

Middle ordinate $= 200 - 179.758$ 20.242 ft.

The length of arc $= \frac{2\pi r\alpha}{360} = \frac{\pi r\alpha}{180} = 181.508$ ft.

The area of sector $= \frac{\pi r^2 \alpha}{360} = \frac{3.1416 \times 200 \times 200 \times 52}{360} = 18151.47$ sq. ft.

The area of triangle $ABO = 179.758 \times 87.674 = 15760.10.$

Area of segment $= 18151.47 - 15760.10 = 2391.37$ sq. ft.

Reclamation Notes

CALIFORNIA.

The irrigation ditches in the vicinity of Browns Valley and Smartsville are being cleaned out preparatory to being put in condition for the transference of water this spring and summer.

The East Park reservoir of the Orland Reclamation Project is full of water. When measured recently there was found to be eighty-five feet of water. This will insure plenty of water for irrigating the lands in the project.

A delegation of probably twenty local and Tehama county property owners went to Sacramento recently to appear before the Legislature and protest against the passage of a senate bill, which provides that irrigation ditches may be carried across the lands of private owners without being compelled by law to furnish water to those lands.

Over 250,000 acres of rich land in the Sacramento Valley are being irrigated by the Kuhn Syndicate. This project is reported to be of more importance than the one at Twin Falls, backed by the same responsible company.

It is possible that there will be an extensive irrigation system developed in the Little Simi Valley, about twenty miles east of Oxnard, the system to have its center at the Warne Brothers' ranch.

J. L. Slater, the promoter, who organized the Tehama Irrigated Lands Company and purchased many thousands of acres of farming land in the vicinity of Red Bluff with a view to colonizing it, recently filed six deeds of this land from himself and wife to the Tehama Irrigated Lands Company, the combined tracts covering 3,000 acres of land.

More than 500,000 acres of land under a $10,000 irrigation system has been added to the resources of southern California through the Chucawalla bill by the recently adjourned Congress. Actual work on this great project was started in March, when two surveying crews left Los Angeles for the dam site on the Colorado river. The Chucawalla and Palo Verde valleys are to be brought under cultivation by this project.

For the irrigation of alfalfa on the red hills near Wheatland, a number of wells will be sunk in time to furnish water for the summer's irrigation. The first well will be sunk on the Oakley tract, which the owners wish to maintain as demonstration of what can be done on the red lands adjacent to Wheatland. The idea is to show that with irrigation anything can be grown on the red soil.

The Senate has passed the bill by Assemblyman Griffin of Modesto to give Boards of Directors of irrigation districts power to levy assessments to pay regular expenses or meet emergencies without calling an election. It is provided, however, that such assessments must be levied by at least four-fifths of the directors of a district.

The citizens of Orland and residents of the surrounding country are planning a great celebration when the irrigation system of the Orland project is opened and the water distributed over the land. It is expected that the system will be completed about the middle of April.

A decision was handed down in the Supreme Court recently upholding the injunction granted in 1904 to J. J. Stevinson, a corporation, prohibiting the San Joaquin and Kings River Canal & Irrigation Company from taking more than 760 cubic feet per second from the San Joaquin river through its two canals at Firebaugh ferry, in Fresno county.

The United States department of agriculture, in a bulletin just issued, reports that construction work is now under way, which will, when completed, result in the irrigation of 750,000 acres of land.

The canal dam north of Knight's Landing was recently cut and the flood water discharged into the Yolo and Colusa basin, thus doing away with the menace to the reclamation districts in that section.

Reclamation district in Yolo county will cover its levee with a sheet of concrete to make it impervious to washing when the water is high outside it.

Deep snow in the higher mountains surrounding the Sacramento Valley assures plenty of water for mining, electric power and irrigation during the coming summer.

It is reported that the Sutter-Butte Canal Company recently purchased the Butte County Canal Company properties, paying over a million dollars, and that they will extend the system for irrigation purposes in Sutter and Butte counties. The project consists of 57 miles of canals and 131 miles of laterals.

UTAH.

Suit was recently started in the United States district court by the Utah-Colorado Cattle & Improvement Company against the Paradox Irrigation and Land Company to recover $2,400 damages alleged to have been done to property of the plaintiff company by the breaking of a dam owned by the defendant company.

At a mass meeting of the citizens, city and county officials and members of various irrigation companies of Webster county, the project for constructing for Ogden and vicinity a monster reservoir in South Fork Canyon was carried through. Sufficient stock in the proposition was subscribed to assure the success of the enterprise. The company will be incorporated under the laws of Utah, with an authorized capital stock of not less than $750,000.

While the big Weber and Davis counties canal is being rushed to completion, preparations are being made to start work on the enlargement of the mammoth reservoir in East canyon, a tributary to Webster canyon, about twelve miles above Morgan.

The present reservoir, which has a capacity of 6,000,000 cubic feet, and is 145 feet in depth above the outlet tunnel, is to be increased to a capacity of 1,200,000,000 cubic feet by enlarging the dam.

The Delta Land & Irrigation Company has recently been organized to take over the Oasis project to reclaim 43,000 acres of land in northern Millard county, which was abandoned by the Oasis Land & Irrigation Company a year ago when its big diversion dam in the Sevier river went to pieces. They will rush the work to completion this year.

A bill was recently introduced in the House by the Committee on Irrigation providing for the selection of reservoir sites, construction of reservoirs and empowering the state land board to make loans from reservoir land grant fund.

Chief Engineer Davis, of the reclamation service, met with the board of the Strawberry Valley Water Users' Association and suggested that the capital stock of the corporation be increased from $40.00 to $60.00 per share J. S. McBeth, president of the association, has called a meeting of the stockholders to be held in Spanish Fork City pavilion, Payson, April 17th, with the hope that this can be done in order that the work may be pushed through and completed.

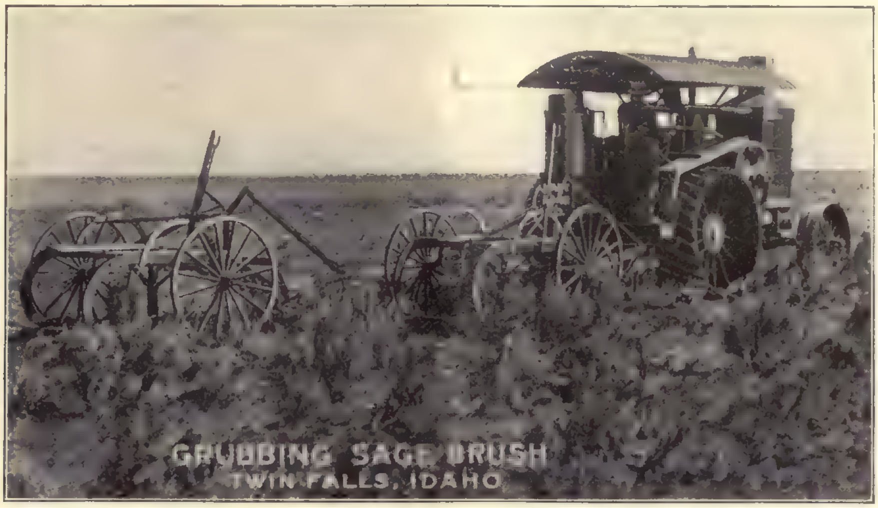
WASHINGTON.

Officials of the U. S. Reclamation Service and farmers on irrigation projects are looking forward to an exceptional crop season. Advices from the several projects are

(Continued on page 872.)

WILL RECLAIM BIG ACREAGE.

The reclamation service headquarters in Boise, Idaho, has been notified by the Secretary of the Interior that $1,000,000 of the reclamation bond issue, appropriated by Congress at the last session, will be used immediately to commence construction work on what the service claims will be the largest irrigation dam in the world. It will be erected on the Boise River, 35 miles northeast of that city, behind which water is to be impounded in the reservoir formed, for use on the Payette-Boise irrigation project located in western Idaho, and comprising 270,000 acres. This will form another good agricultural district near Boise.



Hart-Parr Company's Traction Engine Grubbing Sage Brush Near Twin Falls, Idaho. Made by Hart-Parr Company, Charles City, Iowa.

MINNESOTA FOLLOWS OTHER STATES.

In the case of the International Harvester Company of America vs. Charles Cater, the United States Circuit Court at Fergus Falls, Minn., Judge Willard presiding, on January 28th held that the defense that a company is a "trust" or "illegal combination" is not a good defense, either under the Sherman anti-trust law or under the laws of Minnesota.

Cater was administrator of the estate of F. L. Wilkins, deceased, of Marshall, Minn. Wilkins was an agent for the company, and the proceeding was to compel Cater to turn over the proceeds of sales that had been made by Wilkins pursuant to the terms of a commission agency contract; also to recover property and for implements sold to Wilkins.

An erroneous account of what was decided in this case on a previous occasion has recently appeared in certain newspapers. They reported the reverse of what was then decided.

It has also been decided recently in Michigan, Indiana and Ohio, that a purchaser of an article cannot avoid paying for the property purchased by undertaking to plead the illegality of the contract of purchase and sale.

Mr. Justice Holms, of the Supreme Court of the United States, in one of his recent decisions, said: "The policy of not furthering the purpose of the 'trust' is less important than the policy of preventing people from getting other people's property for nothing when they purport to be buying it."

The absurdity of such defense as was offered in the Minnesota and other similar cases must be apparent to every fair-minded man. All business concerns will welcome the news that as fast as such pleas are presented they are given the adverse ruling. The courts uphold common honesty, at least, and the sooner

(Continued from page 870.)

to the effect that the unusually heavy snowfall at the headwaters of the streams on which they are located has already nearly filled the reservoirs. This assures an abundant water supply to the settlers.

Believing that the completion of the Wapato irrigation project, involving 120,000 acres of land on the Yakima Indian reservation must be brought about with funds now held for the Indians, the Toppenish Commercial Club recently sent a lengthy letter to the Secretary of the Interior suggesting that this be done if possible.

With settlers flocking into the country by the scores work on irrigation systems about White Bluffs is being rushed with all speed practicable. Eight thousand acres are to be watered by the low line ditch of the Wahluke irrigation project this spring and 20,000 acres will be irrigated on the completion of the high line ditch.

Plans to i.rigate 2,000 acres of the lower Eureka Flat district by building a canal 12 feet wide, 3 feet deep and 33½ miles long to connect the district with the Touchet river, are expected to materialize within a very short time.

IDAHO.

S. D. Boone, who was the first manager of the Idaho Irrigation Company, says that the capacity of that company's Magic Dam, that is situated about 16 miles south of Hailey and backs water to within 12 miles of Hailey, is oved 210,000 acre-feet. It is said to be the biggest, highest earth dam in the world, and it has a concrete core reinforced with sheet steel on each side.

The Idagon Irrigation Project, which will furnish water for 20,000 acres of fine fruit land in Owyhee county, was purchased recently by W. H. Abel, lawyer; J. C. Hayward, broker, and E. F. Taylor, contractor, all of Portland Oregon. The purchasers will at once complete the work and will have water ready for delivery in 1912. The old company had constructed 21 miles of canal and had done considerable work on the reservoir on Sucker Creek, from which water for the project is to be secured.

The unique pumping plant of the Snake River Irrigation Company, located on the Snake River immediately west of Payette, is completed and ready to furnish water for a large acreage on Dead Ox Flat. It is the second plant of its kind ever built.

MONTANA.

Consulting Engineer Robert Sibley visited Butte recently where he was in consultation with the Plainsmont Company regarding plans for the irrigation of a large tract of land near Plains. G. R. Wharton, A. H. Wethey, C. A. Henderson and several other men prominent in business circles form the personnel of the company, which owns over 4,000 acres just across the river from Plains and all water rights in Swamp Creek, which flows through the tract.

Suit for $3,500 damages was recently brought against the Bitter Root Irrigation Company in the district court by Gilmore D. Pierce. The action was based on the allegation that the defendant company broke a contract with the plaintiff.

OREGON.

The traffic department of the Oregon-Washington Railway and Navigation Company is receiving numerous inquiries regarding the opening of the fourth unit of the Umatilla irrigation project in northeastern Oregon. This is near the town of Hermiston. The federal department has just completed a huge dam site at this place at an expense of $1,250,000. The third unit was thrown open to settlement February 2nd. The rest of the land in the project will be open for entry within the next year.

Work on a big irrigation ditch at West Stayton is being carried on at the present time, the company having 60 men and 25 teams engaged in excavating. The ditch is being built large enough to supply water not only to the land controlled by the company, but to adjoining farms if desired by the owners.

J. R. Blackaby, president of the Ontario National Bank of Ontario, predicts a great growth for Ontario and Malehur county during the next year, based on the opening of 10,000 acres of irrigated lands tributary to that town. the general spread of information as to the eastern Oregon opportunities and the probability that present railroad activity will make Ontario the junction point of the east and west line of the Oregon and Washington Railway.

Although the rainfall of the Willamette valley has been considered ample for practically all purposes, a proposal to irrigate this land is before the people. A company has been formed at Portland and a tract near Salem will be watered by means of a canal from the Santin river. Land has been purchased and work is now going forward on irrigation canals, which are to be completed in time for watering next season's crops.

Owing to the opening of irrigated lands by the government in Central Oregon, local representatives of the Great Northern railway are expecting a rush of tourists and colonists with the opening of the colonist season.

It was expected that before the first of the present month the reorganizing of the Dechutes Irrigation & Power Company as the Central Oregon Irrigation Company would be completed and the bonds of the new company exchanged for those of the old, but delay in the arrival of the members of the reorganization committee prevented this. Engineers who reported on the project recently say that it will require but a short time to entirely clean up the first two segregations and leave a good profit for the company.

Eight bills have been enacted into law by the recent Legislature which tend to strengthen and make more complete the water laws of Oregon. Perhaps the most important of these is the act extending the present irrigation district law.

NEW MEXICO.

An eight million dollar enterprise is now understood to have been finally launched in Colfax County, uniting half a dozen big projects in an undertaking to reclaim a total of 150,000 acres, almost as large a tract as will be irrigated by the immense Elephant Butte dam of the government on the Rio Grande. This project, if carried through, will be one of the most ambitious in the history of irrigation in the southwest.

The election for the approval of the bond issue of $480,000 of the Orchard Irrigation District in San Juan county was held by the residents of that district recently, the bonds carrying by a vote of 13 to 2. This district is organized under the same law as the Estancia Irrigation district and will mean a great deal for the apple country.

The report that the Estancia Irrigation district could not find a market for its bonds was misleading, as a representative of the General Electric Company of Schenectady, New York, was recently in Estancia in consultation with the board of directors and virtually offered to install the whole plant and take the bonds as payment.

That 750,000 acres are now under irrigation in New Mexico and that water is now available for a total of 4,000,000 acres, are two interesting statements in a report for the past two years just issued by Territorial Engineer Miller. He estimates undeveloped water power at a half million horse power, and shows that $7,000 is being spent annually for the collection of data on New Mexico's water resources.

The approval by the New Mexico irrigation engineer of the application of the Gila River Power Company to appropriate water from the Gila river for irrigation and power purposes, clears the way for one of the largest

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tracts, and appropriate them to an independent use; but the natural flow of water saved by the reconstruction of its original dam is in no sense such salvage waters. *Evans* v. *Prosser Falls Land & Power Co.* Supreme Court of Washington. 113 Pacific 271.

ORGANIZATION OF IRRIGATION DISTRICT—

A petition filed in the district court by the board of directors of an irrigation district, under the provisions of section 2401, which sets forth in a series of special allegations the various steps taken in the issuance of its bonds, but omits to allege generally that "due and lawful proceedings were taken to issue bonds," is sufficient, where the allegations of fact are such as to support the finding of the court that such proceedings had been duly and regularly taken. *Emmett Irr. Dist.* v. *Shane.* Supreme Court of Idaho. 113 Pacific 444.

DAMAGE BY SURFACE WATER—

An owner of upper land may have the surface waters from his land flow in their natural course down on the lands below, but he may not, by the construction of ditches, turn waters, which have naturally accumulated in ponds on his land, on the land of his neighbor lower down, and, where water is thereby caused to flow on the land of another which would not naturally flow thereon, there is an invasion and injury to his right of property and a nuisance per se, the continuance of which he may restrain. *Galbreath* v. *Hopkins.* Supreme Court of California. 113 Pacific 174.

IRRIGATION DITCHES IN STREETS—

Under Baker City Charter (Sp. Laws 1903, p. 609) subd. 59, authorizing the city council to regulate, provide for, and prohibit the construction, building, use or operation of irrigating ditches, on any of the streets of the city, and to provide for the removal of the same, the city council may make such reasonable regulations by ordinance for conducting water along the streets as may be reasonably necessary, and when that has been done an irrigation company maintaining irrigation ditches along the streets must comply therewith. *Baker City Mut. Irr. Co.* v. *Baker City.* Supreme Court of Oregon. 133 Pacific 9.

PRIORITY OF APPROPRIATION—

In a suit to determine the extent of priority of appropriation of water for plaintiff's ditch in which the capacity of the ditch was contested, the fact that a test of capacity was made with water diverted from another ditch, heading higher up on the supply stream, was material only on the question of the volume of diversion plaintiff's ditch was wont to make, and was immaterial where there was other ample evidence to support the quantity awarded by the decree, especially where the ditch carried, during the test, more than the decree awarded to it. *Johnson* v. *Sterling Irr. Co.* Supreme Court of Colorado. 113 Pacific 496.

ARTICLES OF INCORPORATION.

La Noris Irrigation and Development Company, Raymondville, Texas. Capital stock $18,000. Wm. Overstreet, S. L. Gill and C. H. Pease.

Columbia-Clarke Land & Irrigation Co., Spokane, Wash. Capital stock $22,000. Barnett D. Dixon, Otto Hubenthal, Wm. Feldman.

Deer Lake Land Irrigation Co., Spokane, Wash. Capital stock $40,000. Peter Gardiner, W. R. Eisenhour and M. M. Eisenhour.

EVERY FARMER CAN HAVE RUNNING WATER.

The one big advantage usually claimed for the city is running water where needed. There is no good reason why nearly every country place should not enjoy similar advantages in house and grounds and have water for irrigation and the many other uses to which running water can be profitably put.

There are few places not located within a mile of a stream or pond. With a fall of two feet or over a hydraulic ram can be installed to pump to a height of 30 feet for every foot of fall. It will work day and night without attention. The operating expenses will be the renewal of rubber valves every year or so.

The Rife Engine Co. claim a pumping efficiency for their Rife ram of 60% to 90% depending on ratio of fall to pumping head. Any size ram, pumping from three to 700 gallons a minute can be obtained.

The big advantage over all others claimed for the Rife ram is its power to pump air with the water and against a 60 lb. pressure in a pneumatic tank. This air supply also prevents water-logging and destruction of pipes by concussion. This is a very important feature and should make this ram markedly superior to all others.

Rife rams are in constant use all over the world. It is claimed that nearly all the testing laboratories in colleges and institutions here and abroad, over forty of our big railroads, and hundreds of private estates have been using Rife rams successfully for years.

By addressing the Rife Engine Co., at 111 Broadway, New York, catalogues, complete plans and estimates for any place will be gladly furnished free.

There are Reasons for Shipments Like These

RUMELY OILPULL TRACTOR LA PORTE IND.

¶ One can get a pretty good idea of what kind of satisfaction the is giving in the field from the way we are shipping them.

¶ A busy shipping department is always indicative of quality product, right prices, good terms, square dealing and pleased customers.

¶ people wouldn't be buying if the OilPull were not right. If they were not buying we would not be shipping.

¶ And, there are other reasons.

WHAT SOME USERS SAY

"For durability and economy the OilPull has no equal in the field, and for easy starting in cold weather it has astonished all operators of other makes of tractors." J. M. CHICOME, Jefferson, S. Dak.

"The OilPull Tractor I bought of you seems to be the greatest puller I ever saw for plowing this prairie sod." A. E. VASEY, Mott, N. Dak.

"I learned to run the OilPull in a very short time. It is simple, economical and strong enough to run any kind of a separator." EDWIN J. JACK, Terence, Man.

"I regard the Oilpull as a fuel saver, the best built and most powerful engine on the market." BENTON DONER, Potter, S. Dak.

"I can say it develops more power than you had claimed for it, and I am highly pleased with my purchase of a Rumely OilPull." GEO. W. HAZEN, Reeder, N. Dak.

WHAT THE OilPull IS

¶ The OilPull type "E," 30 tractive, 60 brake horsepower, is a four-cycle, internal combustion engine, with two cylinders, 10-inch diameter, 12-inch stroke. It is equipped with an automatic governor, oil-cooled, has both splash and force-feed lubrication, built strong and rigid, tractor frame and parts of wheels solidly riveted together.

RUMELY OILPULL TRACTOR LA PORTE IND.

¶ Now, ever since plowing season was over last Fall, we have been working a day and night force, making these tractors to supply the Spring demand, and now we are filling the orders.

Is Your Order Entered for an OilPull Tractor?

¶ It is a money-making, profitable investment for any farmer or thresherman. Write us for literature.

M. RUMELY CO. 1731 Main Street LaPorte, Ind.

I LOVE MY COUNTRY, BUT OH YOU CANADA.

8,000 acres good black loam on clay subsoil.

Price, $12.00 per acre.

Terms, $4.00 per acre cash, balance in 8 equal annual payments.

This land is located near Wadena, Saskatchewan, on main line of Canadian Northern Ry.

An investment that will pay you handsomely.

For further particulars write or call on

C. A. Comley,
169 E. Third St., St. Paul, Minn.

THE SALT RIVER PROJECT IN ARIZONA.

The Secretary of the Interior has awarded contract to the Byron Jackson Iron Works, of San Francisco, California, for furnishing six centrifugal pumps for use on the Salt River irrigation project, Arizona. The contract price, f. o. b. cars at Berkeley, California, is $7,845.

Contract has also been awarded to the Kagner Electric Manufacturing Company of Saint Louis, Missouri, for furnishing six motors and transformers for these pumps at $7,778.18, and to the Westinghouse Electric and Manufacturing Company of Chicago, Illinois, for furnishing switchboards at $1,411.

Progress is being made on the Beverly Investment Company's project on the upper Columbia river near Beverly, Wash., where 1,400 acres of land will be watered by a steam plant. Chicago capital is interested in the development work. The pump to be installed has a capacity of 6,000 gallons a minute and will deliver water for domestic use under a pressure of thirty pounds.

F. W. Manzer of Big Lake, Wash., has bought a homestead near Coulee City, Wash., which he will reclaim by irrigation, obtaining the water from wells. Fifty acres of land is adapted to fruit.

CLASSIFIED ADVERTISEMENTS

(Continued from page 872.)

private irrigation projects in the southwest. This company, which is capitalized at $6,000,000, proposes to build a dam across the deep Box canyon of the Gila river, twenty-four miles east of the Arizona line in Grant county, storing sufficient water for the irrigation of 50,000 acres.

At a meeting of the board of directors of the Elephant Butte Water Users Association at Las Cruces a plan was tentatively outlined for the inauguration of a policy whereby the Water Users Association may co-operate with the reclamation service in the work of utilizing the power of the Rio Grande project. It is believed that a plan can be perfected that will meet the approval of the secretary of the interior.

Workmen are busy strengthening the dam at the M B. Goldenberg irrigated farm, two miles north of Tucumcari. This has been made necessary on account of the large body of water which has accumulated there. At present Mr. Goldenberg is irrigating about eighty acres, but as soon as the present dam is completed, a new one to hold water for about three hundred acres will be started.

The announcement of the reorganization of the Southwestern Irrigation Land & Power Company is of great interest to Albuquerque and vicinity. This company controls one of the largest and most important irrigation and farming properties in New Mexico.

An Irrigation Club has been organized at Willard, the object of the organization being to purchase engines and pumps in carload lots, thus getting bedrock prices both on material and freight.

COLORADO.

Plans are being made for the establishment of a new irrigation district to be located near Pueblo and a petition to organize the Pueblo County Municipal Irrigation dis-

(Continued on page 881.)

(Continued from page 859.)

of the structure, on the principle of the well-known "gravity" type of dam.

Dams to be constructed on alluvial foundations should be designed with the maximum width of base which is consistent with economy; therefore, the gravity type of dam, constructed of reinforced concrete, is especially adapted to the requirements.

In low wooden structures of the gravity type there is danger that they may float during a period of storm-flow of such depth that the gravity head, on which such dams depend for their stability, may be destroyed. By the use of reinforced concrete, however, this source of danger may be eliminated.

Figure 3 and 4 indicate two variations of design for gravity dams of reinforced concrete which permit of removing the forms and filling the compartments with sand or other heavy material, in order to give additional weight to the structures, or, if suitable air vents are provided, the compartments may be allowed to become filled with water.

From the simple inclined platform to the large hollow structures of the Ambursen type, the gravity dam of reinforced concrete offers a sufficiently wide range of variation to meet the requirements of almost any locality, or any individuality of taste in engineering design.

Table I.—Velocity of flow of water, in feet per day in screened gravel, assuming 40 per cent porosity, based on experiments of the Massachusetts State Board of Health.

	Effective Sizes, in Millimeters.									
Slope, s.	3	5	8	10	15	20	25	30	35	40
0.0005	28	82	164	246	410	656	902	1,280	1,640	2,050
0.001	57	172	335	475	820	1,210	1,680	2,250	3,030	3,690
0.002	115	328	639	902	1,550	2,250	3,030	3,930	4,830	5,820
0.004	221	631	1,230	1,700	2,870	3.930	5,000	6,060	7,130	8,200
0.006	336	918	1,690	3,250	3,690	5,080	6,390	7,620	8,930	10,100
0.008	443	1,160	2,060	2,780	4,340	5,900	7,380	8,930	10,400	11,800
0.01	549	1,410	2,460	3,150	5,000	6,800	8.440	10,000	11,500	......

(Continued from page 878.)

trict will be presented to the county commissioners by O. L. Brown, H. M. Shoup and Edward Case. The proposed district will comprise about 60,000 acres south of the Arkansas river and east of Pueblo. The water rights to be acquired comprise water from the western slope, which will be diverted into the Arkansas.

The Great Northern Irrigation and Power Company, known as the Hughes-Kilpatrick Ditch Company, placed on record recently a contract between itself and the state for the segregation and sale of 140,000 acres of land previously withdrawn from entry by the government under the Carey Act. It is understood that the project has been financed and that water will be put on the land within three years.

Ten thousand acres of arid land in eastern Weld county are to be reclaimed by means of pumping plants. This is one of the most important plants for irrigation by means of pumps ever attempted in Colorado.

No definite word has been received from Paris about the availability of the $2,000,000 for the completion of the Standley Lake irrigation project, but Attorney Milton Smith states that very shortly there will be news of general interest to give out concerning it.

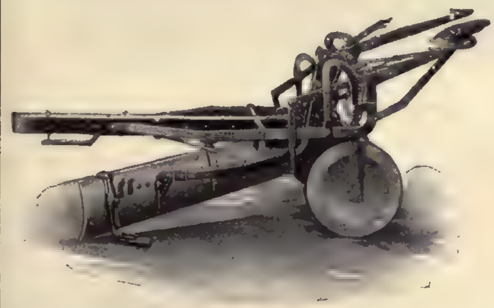
Under authorization of act of Congress, passed March 1st, the Greeley-Arizona Irrigation Company, composed of Los Angeles, Arizona and Colorado capitalists, is preparing plans for the construction of a great dam on the Colorado river, for the purpose of irrigating the lands within the boundaries of the Colorado Indian Reservation.

In spite of the extremely dry weather during the winter, Morgan county irrigationists are optimistic. The rainfall for November, December, January and February amounted to .47 of an inch. The big Jackson lake, the immense storage reservoir of the country, has twenty-seven feet of water against the headgate; the Riverside, which was enlarged last season, has seventeen feet and the Empire, the storage reservoir of the Bijou system, has fifteen feet. This is sufficient water for early irrigation.

A proposition to irrigate 1,200 acres of land near Fort Lupton for truck gardening purposes was presented to the commercial club recently by an engineer of the Northern Colorado Power Company. The plan is to sink wells and get the water on the lands by means of pumps driven by electricity.

A large number of bids for the completion of the Lake Hattie irrigation system were opened at Denver recently and contracts will be awarded as soon as the figures can be gone over and the value of the bids determined. The face of the dam will be covered with concrete, the water being turned in and the concreting done from rafts as the water rises.

Here's What the 20th Century Will Do for You



Notice Grader has only two wheels. Both behind blade.

Slash off sage brush—
Level fields for irrigation—
Cut laterals for irrigation—
Cut side ditches—
Make shallow drainage ditches—
Clean laterals and throw borders—
Move dirt and drop it anywhere—
Do the work of heavy graders at half the cost.

All Irrigation Made Easier and Cheaper

The 20th Century Grader is of all steel construction and weighs but 600 pounds. It takes but one man and one team to operate it, yet it will do more work and better work than any big heavy grader made—and at half or a third the cost.

Thousands in use and giving satisfaction.

Send coupon for full particulars.

BAKER MFG. CO., 526 Hunter Bldg., CHICAGO

COUPON.

BAKER MFG. CO., 526 Hunter Bldg., Chicago.

Gentlemen—Please send me free full information about your 20th Century Grader.

Name.......................................

Address.......................................

R. F. D.................. State..................

The Lowest Cost per Cubic Yard

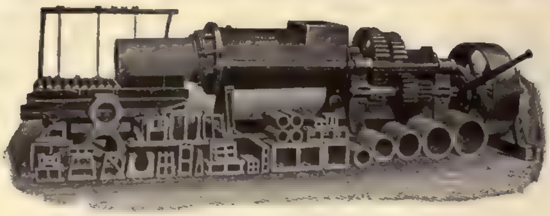
In constructing irrigation canals and laterals, is reached with the

Reclamation Ditcher

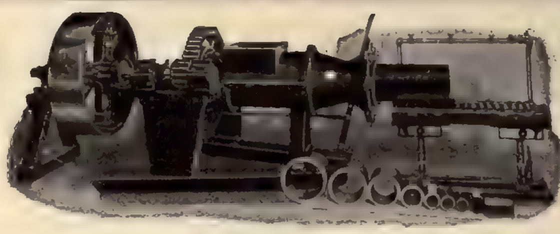
Starting and Finishing Large Ditch at Bloomfield, Colo.

Give us description and size of your ditches and we will tell you the cost of doing your work with this machine. Then if you are interested, we will ship the machine to you, freight prepaid, send an operator and make a demonstration on your work. If we fail to prove our claim you are under no obligation to buy. Fair enough, isn't it?

The Adams Ditcher Co., Indianapolis, Ind.

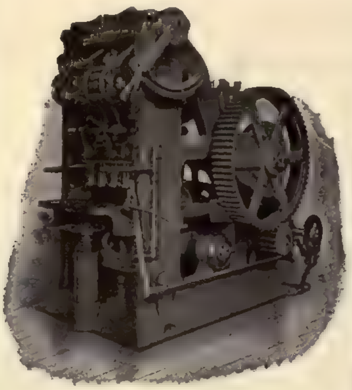


Centennial Auger Machine

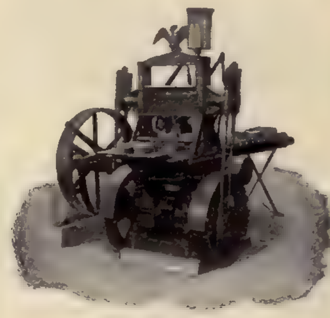


Mascot Auger Machine

Wheelbarrows and Trucks



Dry Press, 5 styles



Eagle Repress

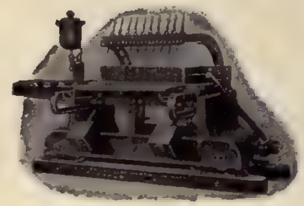
Clay Working Machinery

"BUILT RIGHT—
RUN RIGHT"

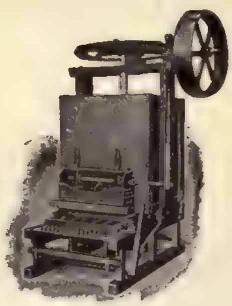
We build an entire line of Clay Working Machinery for the manufacture of Clay products by all processes, including Sand-Line Brick. Our yard supplies are the best. Kiln Irons, Cutting Wire and all supplies. Send for information or catalogue.

The American Clay Mch. Co...Bucyrus, Ohio

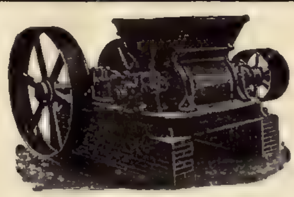
Dry Cars, all kinds



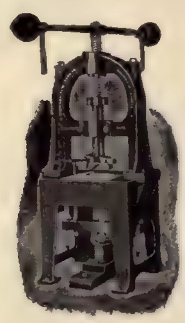
Hand and Power Cutters



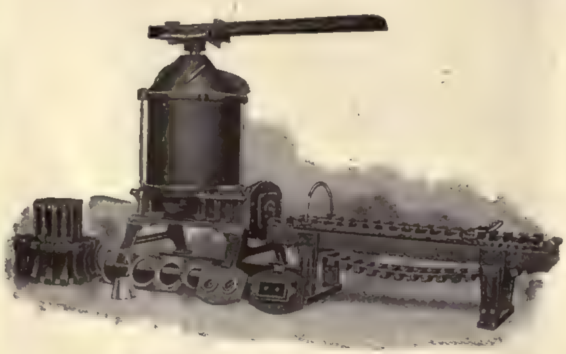
Soft Mud Machines, Horse and Steam Power



Disintegrators



Hand Power Screw Press



Horse Power Plunger Machine

Products of our Auger Machines

Ask for Our Tire Book

Cut Tire Bills in Two

We have made enough No-Rim-Cut tires to supply over 100,000 motor car owners—10% oversize.

The control of this tire jumped our tire sales last year to $8,500,000. And 64 leading motor car makers have contracted for these tires this year. They now outsell our clincher tires almost six to one.

If you are a tire user you should know these tires. They cut tire bills in two. Ask us to mail our Tire Book.

Goodyear No-Rim-Cut Tire

The No-Rim-Cut tire—like the clinche tire—fits any standard rim for quick-detachable tires. Also demountable rims.

In changing from clinchers, you simply slip each removable rim flange to the other side. Then the tire comes against a rounded edge, as shown in the picture above.

We have run these tires flat in a hundred tests—as far as 20 miles without a single instance of rim cutting.

Ordinary Clincher Tire

With the ordinary tire—the clincher tire—these removable rim flanges must be set to curve inward—to grasp hold of the hooked tire base. That is how the tire is held on.

The picture shows how the thin edge of the flange then digs into the tire. That is the cause of rim cutting. That is what ruins a tire beyond repair if you run it not fully inflated.

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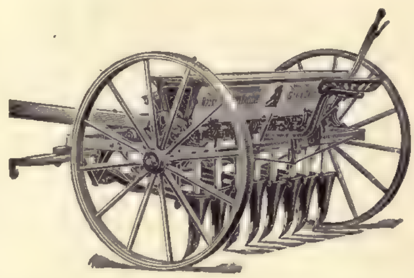

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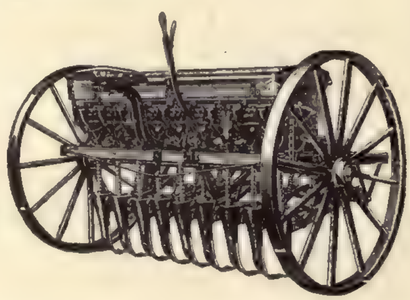

Twenty-sixth Year

THE IRRIGATION AGE

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THE IRRIGATION AGE

With which is Merged

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We take this opportunity to thank our many readers who are favoring us from year to year with prompt renewals sometimes a month or two ahead of the expiration of the same.

Recent Progress in Spraying Compounds.

The Iowa Agricultural Experiment Station has quite recently issued Bulletin No. 24 on the subject of spraying trees with lime sulphur. It is a very useful pamphlet, showing the best methods in use at the present time, of the manufacture of the lime-sulphur and how to apply it. Full directions are given how to prepare the mixture for the home made compound and how to dilute it for the various sprays to combat the different fungi and insect pests threatening the fruit trees under consideration. Every fruit grower should write for this bulletin as the information contained therein means the saving of money for the husbandman interested. Also the Minnesota Experiment Station under date of April 15th, 1911 (No. 8 of Volume II), calls attention to the spraying of the orchard as follows:

The dormant spray of lime-sulphur, and the first spraying of self-boiled lime-sulphur and arsenate of lead, applied as the buds are ready to burst, will have been given at this date. The third spraying of the season (if we count the dormant spray as the first) should now be planned for. The insect we are after at this time in the Codling Moth, or apple worm. The worm stage of this moth is the pinkish white larva that is found so often in wormy apples. The moth lays its eggs on the leaves or on the young fruit, and the little caterpillars hatching from the eggs make their way to the calyx end of the fruit, which at this time is uppermost and wide open. In this calyx cup the insect eats its first meal, afterward eating its way into the fruit around the seeds. Now, if we can get this calyx cup filled with a stomach poi-

son, the first meal of the creature here will be its last. Arsenate of lead, three pounds to fifty gallons of water, is the poison recommended for this spraying. The best time for this is just after the blossoms drop. At about this time, too, the plum curculios are beginning to be active in egg-laying, and the coating of arsenate of lead will kill many of the adults before much damage is done. Self-boiled lime-sulphur used at this time will prevent scab and, to a certain extent, bitter rot, and some of the leaf spots. A combined spray, therefore, applied immediately after the blossoms drop, of self-boiled lime-sulphur wash, to which has been added arsenate of lead (three pounds of arsenate of lead to fifty gallons of the lime-sulphur) is the best spraying material to use at this time.—A. G. Ruggles, Division of Entomology.

Another interesting bulletin on this subject is published by the New Mexico Agricultural Experiment Station (Bulletin No. 175) in which the result of tests are shown, comparing the harvests of sprayed and not-sprayed apple trees; the sprayed trees showed a harvest of 81 per cent of sound apples while the non-sprayed trees showed a yield of only 33 per cent, the other 67 per cent being wormy. This proves that it pays to spray but it must be done at the proper time and in the proper manner with proper ingredients.

Lightning Protection for Farm Buildings and People.

So much has been said and written about the Lightning Rod agent and the victimized farmer that many people think of the lightning rod as a joke. There is no doubt that much defective work has been turned out by unscrupulous concerns or agents in years gone by so that the farmers are mistrusting even the very best firms in this line. Yet a good lightning rod properly put up is a splendid protection against lightning and especially occupants of isolated buildings should see to it that such protection is provided. Where houses are surrounded by trees higher than houses the trees will act as protectors since the lightning when it strikes usually reaches for the highest point of an object which can conduct the electrical fluid into the ground. For this reason ligntning rods are made of some good conducting material like copper, iron or other metals having a gilt point reaching some distance above the highest point of the house. This rod is run then alongside the building down into wet ground and it is obviously necessary that it is insulated from the building by either rubber, porcelain or glass insulator, so that when the electric fluid descends it will follow the rod into the wet ground; should there be a break in the rod or should be one of the insulators broken, then the lightning will jump into the house at such interruption and do usually great damage. Many lightning rods do not accomplish their purposes because they are improperly grounded. This is a thing which is very important and furthermore is dependent upon various conditions. When the ground around a house is moist or when there is a well available the lightning rod can be run right into the well or moist ground, ending with a copper plate say 12 inches square. But when the soil is dry then a larger end plate must be provided so that the contact between the plate and dry ground is sufficient to dissipate the electric fluid; otherwise a heavy bolt might burn out the whole lightning protection, the house included. A copper plate 30 by 30 inches, soldered to the end of a lightning conductor and buried below the ground will be sufficient even in dry earth to make the lightning rod effective.

The most satisfactory protection and at the same time the most natural one is a grove of trees, higher than the house. It takes of course years to raise such trees, where nature has not provided them, and during the time that such trees are growing up an artificial lightning rod will be needed. But after the trees reach a height equal to that of the house they form a very desirable protection against lightning as well as other storms. The many branches and twigs of the trees reaching into the air above the house will draw on the static electricity in the air and low hanging clouds and will dissipate it without the phenomenon of a stroke of lightning. The trees especially have the advantage of always being properly grounded, as the electric fluid following down the trunk of the tree will be conducted by the roots into moist ground where it readily unites with mother earth. Thus it is seen that trees may be depended upon as acting as good lightning rods if they reach up high enough and are not too far away from the buildings.

Trees are however not a very safe shelter for people or animals during a thunder storm, for the reason that lightning may strike a tree most any time and the splintering tree might injure man and beast sheltering under its foliage. Also the lighting following down the trunk may enter the living creatures and kill them. Hence people should not stand under trees nor near high chimneys, or church steeples, telegraph poles, trolley poles, nor should they use telephones during the progress of an electrical storm. Should lightning however strike a person it must be remembered that such stroke is not always fatal and that in a large proportion of cases the victim may be saved. The effect of the lightning is a sort of paralysis of certain parts of the body, usually stopping the action of the heart and lungs; hence the affected person should be at once taken in hand and efforts made to induce respiration and circulation. These efforts must be very persistent; the body must be kept warm and stimulants must be administered and the work of resuscitating must be kept up until the person revives. Always send for the nearest physician in every such case.

Defective lightning rods are perhaps more responsible for damage and fires caused by lightning than any other cause. This stands to reason as the lightning rod attracts the lightning and then fails to conduct it to mother earth, but instead of that permits it to enter the house. Thus if the insulators of a lightning rod are broken or if the lightning rod itself is disconnected the plant should be repaired immediately in proper manner; if this cannot be done it will be better to take down the whole lightning rod, for the building will be much safer without the rod than with the defective one.

Irrigation and Drainage Go Hand in Hand.

There is hardly a farm anywhere which is provided by nature with just the exact amount of water for the production of the most satisfactory crop. There is just as often too much as there is too little water; moreover, at times of the year when the precipitation is at its maximum the water bench rises in the soil until it actually drowns out and destroys the vegetation it is supposed to feed; the only way to cure this is to drain the land so as to draw the level of water down to a point where it will do no damage. This work is done either by ditches or piping and care must be taken not to draw the water off too much. Different crops require of course different amounts of water, but as a general proposition the water should not be drawn any lower so the roots of plants are able to reach it and draw it up for their nourishment. Such drainage water should be made use of again for land lying at a lower elevation as it has many rich salts in solution necessary for plant food which it took up while standing

in the soil; thus the water drained from one farm may be used to irrigate and enrich another farm.

A gravity system of drainage is naturally preferable as its operation cost is practically nothing. There are however, localities where there is no natural drainage and in such case the surplus water must be pumped. In such case the cost of pumping must be considered, and if it can be worked so as to store the water in a reservoir so as to use it when the ground needs irrigation the pumps are doing double duty as their work in draining the land is the first step toward irrigation as well.

It may be truly said that the arts of irrigation and drainage are just now beginning to be developed and that the next decade will see a tremendous advance in this direction.

Irrigation by Pumps and Pipe Lines.

The time will come when all the land that can be irrigated by a gravity plan will have been taken up, and then the reclamation of further land will necessarily depend on the ability of raising water from the deep. This will also include such lands as are now watered by artesian wells which deliver water under a head at present, but the time will come when the pressure diminishes and that water will also have to be pumped. The question whether it will pay to irrigate land by pumping the necessary water will depend on a good many circumstances which should be carefully considered. As a general proposition the government should be first consulted regarding the geological formation, quantity and quality of ground water supply in the region under consideration, next the condition of the soil should be established, which is best done by taking samples at different localities and depths and have them analysed in the various experiment stations. From this information an approximate estimate of the cost of pumping can be made. But the proposition is always one of more or less uncertainty, as no one can definitely state whether a subterranean water supply is permanent, like an underground river or whether it is just a pocket. For this reason the government should devote more work and money to the establishment of hydraulic information in the various states, especially in the arid and semi-arid regions.

The Roosevelt Dam and the Salt River Project.

So much has been said and written about the Roosevelt Dam in Arizona recently that it will not be amiss to briefly review the work done by the government in constructing one of the most gigantic irrigation plants in the world. The purpose of the dam is the impounding of the waters of Salt river for the irrigation of the Salt River Valley in Arizona, reclaiming about 250,000 acres of arid land.

The dam is built square across the bed of the Salt River between the mountains, forming the valley of the river, is 700 feet long, 280 feet high, 170 feet thick at the base and 16 feet wide on top; it is built of concrete and contains 344,000 cubic yards of masonry; the 300,000 barrels of Portland cement required for this structure were manufactured by the government on the ground, thus not only saving about 600,000 dollars in the cost of the cement, but having positive assurance all the time that the material was reliable and available as required. The government likewise built a saw mill in the nearby forrest for all the timber requirements of the project. The reservoir thus formed covers an area of 16,300 acres and forms a lake 25 miles long by 7 miles wide in the widest place. It is over 200 feet deep at the dam but the average depth does not exceed 16 feet, and when the reservoir is full it contains 1,284,200 acre feet of water, which is able to supply the 250,000 acres in the project—something like 60 inches per annum assuming that the reservoir just fills once a year.

These works do not only supply water for irrigation but also hydro-electric power is developed to the tune of 12,000 horse power, which in the course of time can be increased to 25,000 horse power. This power is carried a distance of 65 miles to the town of Phoenix where it is doing duty lighting the streets and propelling cars. There will no doubt be a heavy demand for this source of power for the purpose of pumping from wells in the Salt River Valley on lands which are located too high to be served by gravity flow.

Credit must be given to the government for carrying through such a stupendous engineering feat under such difficult conditions, yet the terms under which the water is made available to the settlers are very easy, as the payments are from 4 to 6 dollars per acre per annum for ten years.

There is perhaps one thing however which may cause serious trouble in the near future and this is the fact that strong leaks are developing in the cliffs which form the two long sides of the reservoir. The dam built by the government is in splendid condition and appears to be perfectly water tight, but the walls which nature built are not proving trustworthy and numerous miniature waterfalls appear on the sides of the cliffs below the dam. This shows evidently that the engineers in charge of the work should not have taken it for granted that hills forming the sides of the proposed reservoir were water tight; they could have with reasonable increased expenditures provided for a water tight concrete floor of the reservoir up to a certain height so that the floor and sides subject to heavy pressure would be completely protected. With a depth of water of 220 feet against the dam it means a pressure of nearly 100 pounds, 94.6 pounds exactly, per square inch and this means that if there is any chance for the water to escape it will find it. Yet it is hard to forecast whether the leaks that are showing now will become worse or close up. It depends much on the nature of the seam that the water is following through the hills whether the leak will gradually be closed by the accretions of silt or whether the water under its high pressure will enlarge the crevices and increase the rippling stream to a raging torrent carrying destruction down to the valley below.

There is no doubt that the government engineers are watching these leaks closely and taking all necessary precaution for the protection of life and property. They can, however, not be too careful when the safety of thousands of people may be threatened by great masses of impounded water at a considerable elevation.

Drainage Problems in the South.

There is perhaps more land within the boundaries of the United States in need of drainage than in need of irrigation, or it might be more appropriate to say that a greater acreage of swamp lands can be drained than there is arid land which can be profitably irrigated. Hence drainage is at present receiving considerable attention, especially in some of the southern states, such as Louisiana, Florida and Texas. There are vast tracts of partially submerged lands in the states of Arkansas and Mississippi, which are in urgent need of drainage, and which will form, when reclaimed, splendid land for all kinds of crops.

There are about four millions of acres of land in the Yazoo Delta, in the state of Mississippi, of which only about one-third is in cultivation. The remaining 2,600,000 acres can be reclaimed by drainage and after clearing off the timber will be capable of producing a very large revenue for the State.

This land should be worth at least 100 dollars per acre when ready for cultivation, and provide homes and means for a livelihood for 100,000 families.

The experience of the State of Missouri in reclaiming a large area of swampland, which formerly sold at from 1 to 5 dollars, and which now readily brings from $50 to $100 per acre after drainage, should impel all States having such land to take steps toward reclamation.

Important Points for Pumping Requirements.

Many an irrigation plant has been spoiled and is operated at a loss because the planning of the works was done in a haphazzard manner and without considering important points which affect the economy of the work. The first consideration is the amount of water actually needed for the land to be provided for. When this quantity is settled, we will say in a certain number of acre feet per annum, then divide this amount by the number of days the pumping plant will be in operation during the year, which will give the requirement per day. As such a plant rarely runs day and night a certain number of hours per day should be assumed, say 10 hours; hence divide the amount required per day by 10x60x60 or 36,000 will give the flow in cubic feet per second. The next important point is the height of the lift; this height is taken from the surface of the water, at the suction end to the center of the stream at the discharge end plus the friction in the pipes and pump measured in feet. For instance, one pump may pump through a height of 40 feet with 50 feet of piping while another pumps the same amount of water the same height through a length of piping 500 feet long; then it stands to reason that the latter case requires more power for its pumping than the former on account of the frictional resistance of the long pipe; this resistance increases with the length and decreases as the diameter increases, so that it is good economy when water has to be pumped considerable distances to increase the size of the discharge pipe. The horse power of the engine required to do the pumping can be found approximately by taking the weight of the water pumped per minute, multiply this by the total head in feet, including resistance, divide by 33,000, which gives the actual water horse power, then double this and the result will be pretty close the requirement of the case.

To show in an assumed problem the application of the above principle let it be required to calculate the size of centrifugal pump, piping and horse power of engine required for the following problem: The number of acres to be irrigated is 20; water requirements 24 inches per annum, which is equal to 2 times 20 times 43,560, or 1,742,400 cubic feet per annum. Divide by 120 as the number of days the plant is operated gives 14,520 cubic feet per day; divide this by 36,000 which is the number of seconds in 10 hours, makes .403 cubic feet per second. Let the speed of the water in the centrifugal pump be 8 feet per second. Divide .403 by 8, gives .0504 square feet, as the cross sectional area of the pump; consult a table of areas of circle or compute the diameter of the required circle by first dividing area by 3.14, extracting square root and multiplying by 2 the diameter of pump is found to be .252 feet or slightly more than 3 inches, say 3½ inches. The discharge pipe should be of a much larger diameter in order to reduce the velocity which reduces the resistance to flow. Assume the length of discharge pipe 200 feet, 6 inches in diameter. The area of a 6-inch pipe is .196 square feet; divide this into .403 cubic feet gives a velocity of 2.05 feet per second in the discharge pipe. A table of resistancies for a six-inch cast iron pipe with a velocity of 2.05 feet per second gives a loss of only 2.67 feet; let the suction lift be 18 feet and the discharge head 32 feet, then the total lift plus the resistance is 18 + 32 + 2.67 ft. = 52.67 ft. To find the horse power multiply the weight of the water pumped per minute with 52.67 and divide by 33,000 times 2. .403 c. f. s. multiplied by 60 gives 24.18 cubic feet of water per minute; multiply this by 62.5 gives the pounds of water pumped, 1511.25 per minute; multiply by the lift plus resistance 52.67 gives 79, 598 foot pounds of work. Divide by 33,000 gives 2.412 net water horse power; multiply this by 2 gives 4.824 gross horse power or say, it requires a 5 horse power engine to run this pump.

Suppose now some one in solving the above problem instead of using a 6 inch pipe wanted to save money by using a 4 inch pipe. In this case the area of a 4 inch pipe is .087 square feet which makes the velocity in the pipe 4.63 feet per second, and gives a resistance equal to 17.5 feet; add this to the 50 foot head, makes 67.5 in all, multiply this with 1511.25 pounds of water pumped per minute gives 102.010 feet pounds, which divided by 33,000 gives 3.09 net water horse power; double this gives 6.18 horse power, which is considerable more than the 5 horse power engine required with the 6 inch pipe. As in this case a 6½ horse power engine would be required, the extra cost of the engine would probably balance the greater cost of the 6 inch pipe not to talk about the greater cost of operating the larger engine.

The foregoing considerations show the necessity of figuring on each irrigation problem the various elements entering into a concise solution of such problem. The "Primer of Hydraulics," which is now in process of evolution and which will be ready for the market by the end of 1911, will just qualify any irrigationist to make his own computations and get satisfactory results.

CONSERVING MOISTURE.

C. W. Grandey, Montana.

Dry farming, as it is practiced in this section of eastern Montana means no more nor less than following those methods in tillage that will conserve all the moisture for the growing crop. It requires the same amount of water to produce a bushel of corn in Montana that it does elsewhere. Our rainfall is fourteen to eighteen inches. We cannot waste the moisture the Illinois or Iowa farmers do. On the bench lands, where the soil is best adapted to conservation of moisture, the plow is followed immediately by a roller or subsoil packer, then disked and harrowed, after seeding with a disk drill. While the crop is growing, the harrow is used as often as a crust is formed by rains until the grain is eight to ten inches high.

As June is usually a month of abundant rainfall, much breaking is done during this period for winter wheat. Where the steam and gas tractors are used, much summer fallowing is resorted to, raising two crops in three years. That the bench lands of Montana will yield abundant harvests of wheat, flax, oats, barley and rye, and even corn, has been demonstrated in the last three years by the homesteader and for many years by the state experiment station. What failures we have here are due to loose farm methods, neglect to harrow and poor seed.

Some results obtained in 1910 were exceedingly good. A neighbor started his steam plow in April on the raw prairie, breaking, subsoil packing, working the ground, seeding with a double disk drill and following with three sets of harrows, all in one operation. Loss of moisture was very slight. In this manner some 800 acres were put in on the bench land. His harvest yielded him better than $10,000. Another neighbor went through the same operation, but at different times, and had almost a total failure.

One summer fallow oats yielded forty bushels, and in the same section this variety of oats on spring breaking, with a few days between disking and harrowing, made five bushels. I certainly have faith in the bench land farming of Montana.

A CELLULAR REINFORCED CONCRETE DAM*

BY GEORGF J. BANCROFT

In modern hydraulic practice there is a great demand for a cheap substantial type of dam, having all the resistant qualities of the monolithic type, without the great expense of that type. I presume that the same demand has existed at all times, but the large number of irrigation and power projects now on foot have accentuated this demand. Several forms of skeleton dams have been proposed and some of them built. These dams, for the post part, consist of a sloping surface of iron, concrete or wood, supported by a framework of the same material. The weight of the water resting on the inclined surface imparts the necessary weight to the structure. I think one of the principal objections to this type of dam is that it *looks* unsafe. People living below a reservoir like to feel that there is something more between them and destruction than a thin plane supported by a few posts.

A dam is a comparatively simple mechanical device. A canon dam with rock abutments is not unlike a bridge lying on its side. A dam which is relatively long, so that the abutments do not contribute to its resistance is not unlike a shelf carrying a uniform load. In this case again the shelf is lying on its side, the load is the horizontal thrust of the water and gravity replaces the fastenings to the wall.

In either case the modern plan of using a built-up structure would seem to promise economy. I see no more reason in using a solid concrete dam than in using a solid bar of iron for an automobile axle. The dimensions of a "gravity section" or "heavy masonry" dam are determined, not from a consideration of the strength of the material used in resisting tensile or compressive stresses, but by making it of such size that weight alone enables it to resist the overturning moment of the water.

In designing a dam to meet these conditions, I have taken reinforced concrete as the most suitable material to furnish strength, and earth or rock as the most suitable material to furnish weight. By combining the two in a cellular form, I believe I have evolved a type of dam that is safe, strong, self-contained and cheap.

Briefly, the dam is built in the general outline of a solid concrete dam, but instead of being solid concrete, it is built like a honey comb, the cells being vertical. The dam will be somewhat thicker than a solid concrete dam, owing to the difference in weight between earth and concrete. After the concrete work is finished, the cells are filled with earth and rocks laid down in water, so in the end the dam is practically a solid mass. The accompanying half-tone gives a general idea of the dam. It is a view of the dam from the rear or down-stream side.

Perhaps the greatest use of the new dam will be in canon dam sites, where the dam is a combination of the gravity and arch types. In such cases it is customary to design the dam so that it will hold back the water of its own weight, and then arch it against the water pressure to secure a large factor of safety.

To illustrate the manner in which this dam works out, I will take a specific instance. In this case the dam is 185 feet high and 1,370 feet along the crest.

The material in this dam is proportioned with due consideration to all the strains that may come upon it. The principal strains are:

(a) The pressure of water when the reservoir is full.
(b) The pressure of the earth filling when the reservoir is empty.
(c) The weight of the superimposed material on the foundations.

The dam is considered, for the sake of calculation, as consisting essentially of a face wall supported in the rear by buttresses. The auxiliary walls which are parallel to the face wall and which complete the enclosure of the cells are considered only as supports to prevent the buckling of the buttresses, as resistance to shear strain and as weight to resist overturning. Their great stiffening effect on the entire structure, and their support and assistance to resisting the strain of the water pressure is not considered. Moreover, the strength of the earth filling in shear and its supporting effect in resisting transverse and longitudinal pressure is disregarded because I wished the structure to be strong enough to withstand all strains without counting on this assistance.

The computations are, therefore, as follows:

First—The proportioning of the dam as a whole so as to resist overturning.

Second—The proportioning of the face wall.

Third—The proportioning and spacing of the buttresses.

Fourth—The proportioning and spacing of the walls parallel to the face wall, which we will call the auxiliary walls.

In a measure, these problems are worked backward, for the general form of the dam and the general nature of the strains suggest a certain arrangement which is assumed at the outset, although the proof of its fitness is the last thing arrived at in the course of the calculations. Thus it is assumed that the cells will be 20 feet, as measured longitudinally on the face wall, and will, of course, be narrowed as the radial buttresses approach the center of curvature of the dam. As measured transversely to the dam, the first tier will be 20 feet, the second 25 feet, and the third and balance, 30 feet, measurements being center to center of retaining walls. The spacing of these walls was decided upon after several calculations to determine the maximum economy in the proportionment of concrete and earth. The only way to decide this matter seemed to be by the "cut and try" method, so five different designs were figured out, and the one presented gave the best results. I think it is self-evident that the face part of the dam should have more concrete and less earth-filling than the rear part, and our "cut and try" calculations verified this assumption. Several formulae were found which almost fitted this case, and it is entirely possible that theoretic perfection may yet be attained, but the present design is sufficiently attractive from a practical standpoint.

As mentioned above, the nature of the several problems continually involves using the ultimate result in the primary calculation. It is therefore more simple, and better suited to the purpose of this article, I think, to assume the entire design as shown on the cross sections presented herewith, and proceed with the calculations to ascertain what the factors of safety may be.

First—To ascertain the factor of safety of the entire dam to resist overturning.

To do this the dam is considered in progressively increasing segments, beginning at the top and going down, the last segment being the entire dam. The width of the base of each segment is determined by the graphic method given by Bulkely on page 184 of "Facts, Figures and Formulae for Irrigation Engineers." The factor of safety consists in the fact that the resultant falls in the middle third of the base of the dam and also in the fact that the dam is arched against the water pressure.

It is evident that for the dam to yield, all the longitudinal walls must be crushed by the longitudinal component of the water thrust and that the buttress walls must be crushed by the overturning movement. By calculations given later on, it will be seen that the factor of safety in the buttresses is 8, without reinforcing. To this must be added the factor of safety protecting the crushing of the longitudinal walls. These walls are supported every 20 feet, at least, by the transverse walls so they cannot yield by buckling, neither can the dam as a whole yield by buckling, if properly curved, as in this case, and not too long in proportion to its thickness.

For the purpose of finding out what factor of safety is contributed by arching the dam against the water, two horizontal segments will be considered, namely, the top 10 feet and the bottom 10 feet. Measured at right angles to the line of pressure, the upper segment is $1270 \times 10'$ and the walls meet the buttresses at an angle of 35° to the line of pressure.

The strain then is

$$\frac{10}{2} \times 10 + 1270 \times 62.5 = 3{,}968{,}750 \text{ lbs.}$$

62.5 being the weight of a cubic foot of water.

This strain is met by two abutments, so it is proper to divide this in two.

$$\frac{3{,}968{,}750}{2} = 1{,}984{,}375 \text{ lbs.}$$

As it does not meet the abutment parallel to the line of

*Read at the meeting of the Colorado Scientific Socity, Oct. 1st, 1910.

pressure, but at an angle 35°, it should be multiplied by the secant of 35°.

$$1{,}984{,}375 \times 1.22 = 2{,}420{,}937 \text{ lbs.}$$

This strain is met by two walls having a total cross-section of 17.5 feet. Each foot will, according to Kidder (p. 227, Architect's and Builder's Pocket Book), resist 440,000 lbs., without reinforcement.

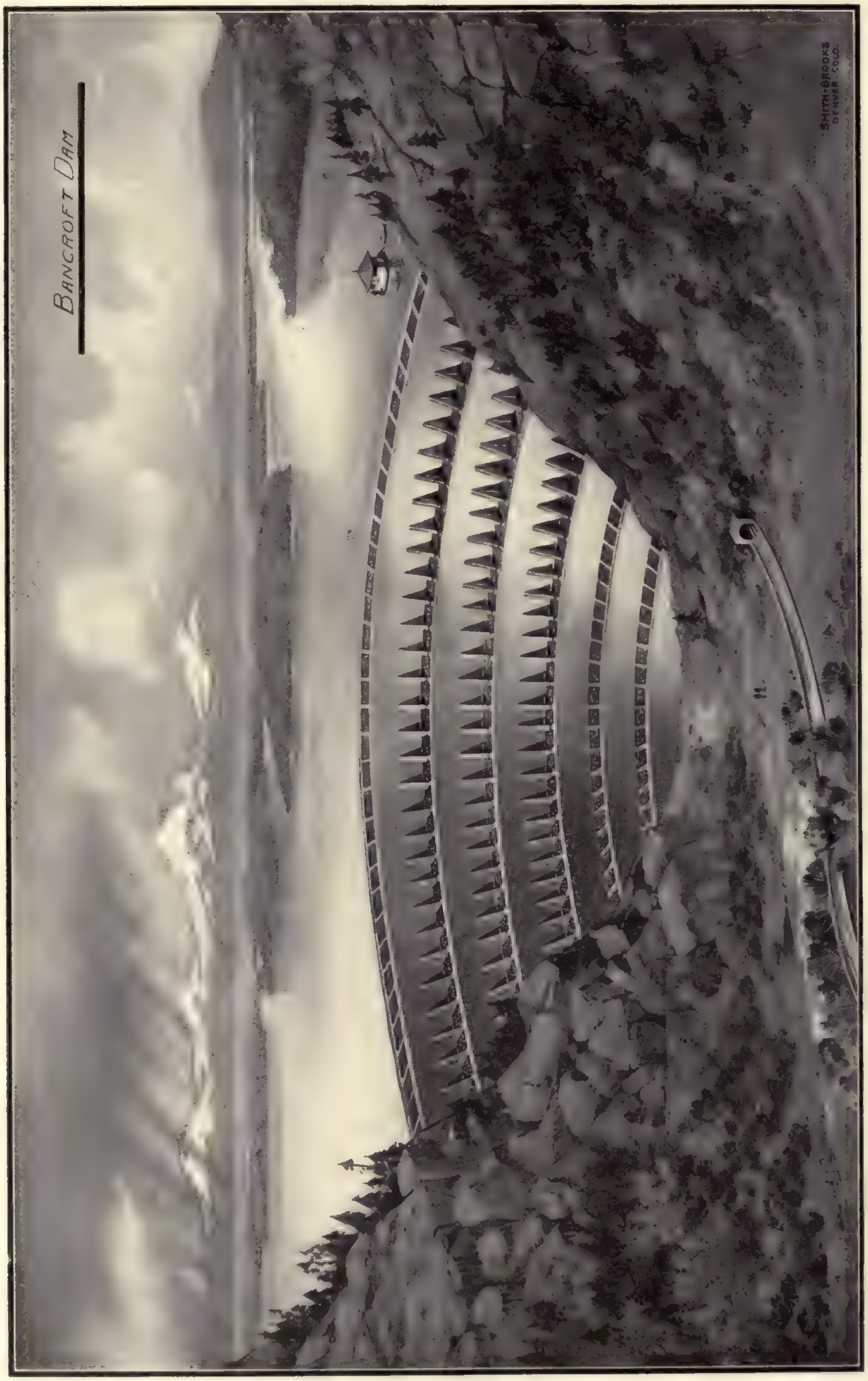
$$17.5 \times 440{,}000 = 7{,}700{,}000.$$

The factor of safety, then, is

$$\frac{7{,}700{,}000}{2{,}420{,}937} = 3 \text{ approx.}$$

Figuring the bottom 10 feet in the same manner, we find a factor of 1½. The average will be about 2¼. It is more important to have the top of the dam supported by the arching effect than the bottom, because in this case the bottom is short and so wedged in between cliffs that it is abundantly secure.

The factor of safety in the buttresses alone is 8. As the dam could not yield in one way without yielding in the other, it is proper to add these two factors of safety together, making a total of 10¼, which will be increased about 12% by the reinforcement (Total, 16) and an unknown amount by the earth filling.



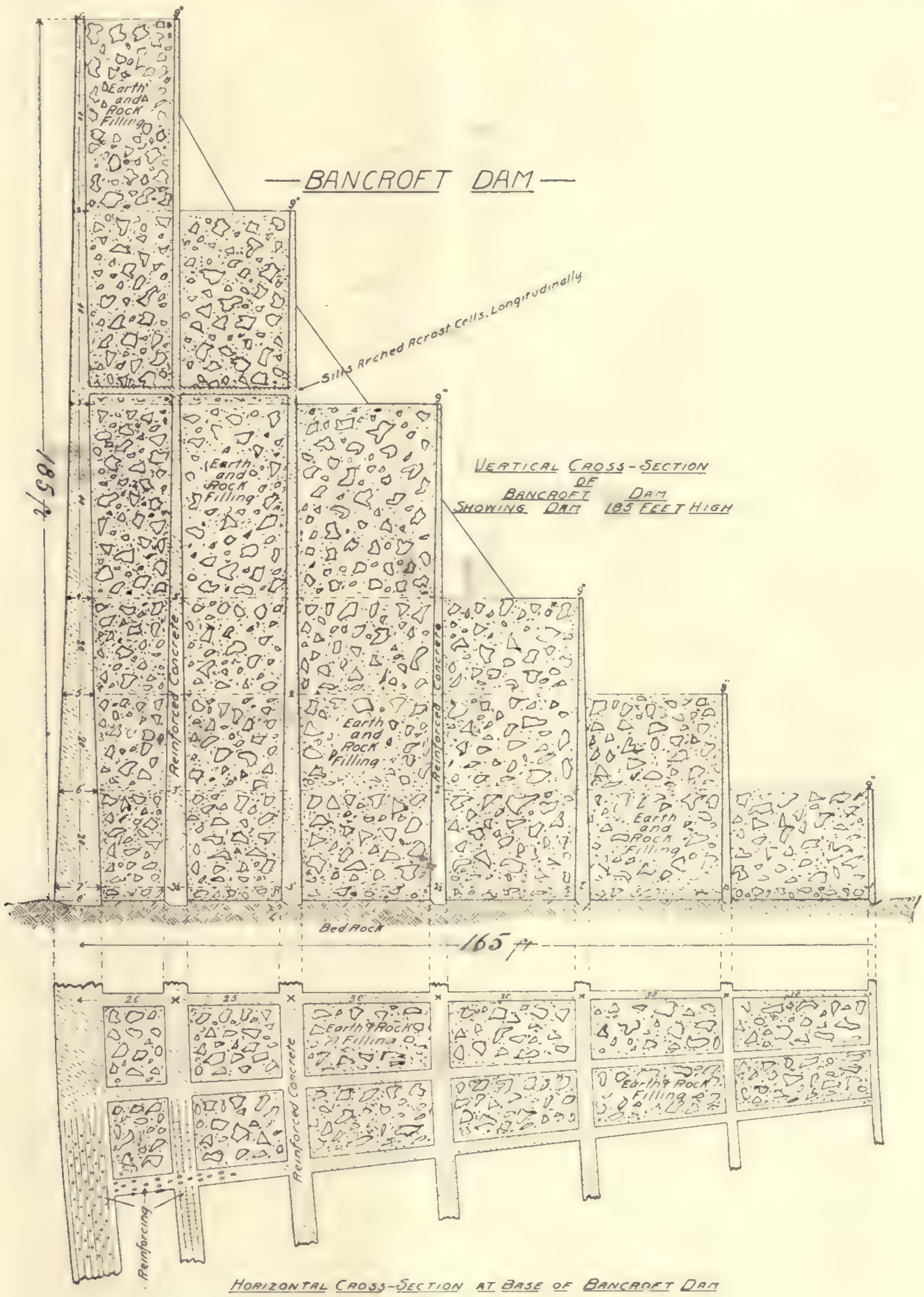
GENERAL ELEVATION OF THE BANCROFT REINFORCED CONCRETE DAM.

It is, of course, conceivable that the distribution of the material might be so at variance with the changes of pressure in depth, that the above calculations, with regard to the factor of safety of the arch, would not hold. This matter, however, has been closely considered and each horizontal cross-section has been designed with regard to the shearing strain which is closely related to the strains above considered.

Second—The proportioning of the face wall.

In this case it is assumed that the water comes flush with the top of the dam. The parapet or extra height of any dam varies with the nature of the case and in this recitation it is omitted. The theoretical width of the face wall at the top is zero. It is, however, designed to be 2 feet thick to resist wave action. The entire width on top, counting earth filling and enclosing walls, will be 23′ 4½″. As the pressure against this wall varies as the depth, and as the top is unnecessarily thick, the bottom is the place to test the factor of safety. In so doing, we will neglect the strengthening effect of the bed-rock key.

The face wall is divided into vertical panels by the buttresses, the one in the center measuring 20 feet horizontally and 185 feet vertically. These panels may be considered as consisting of horizontal slabs or simple beams being supported at each end and being subjected to a uniform load between supports. When the reservoir is full, there will be a pressure on the outside of each slab equal to the weight of the water over the slab considered. When the reservoir is empty, the weight of the earth filling may press outwardly against the slab. The water pressure is easily figured and the maximum possible pressure of the earth filling can be readily ascertained, but there are other possible strains not so easily estimated. There is an indeterminable strain due to a possible



HORIZONTAL CROSS-SECTION AT BASE OF BANCROFT DAM

PATENTED.

slight yield of the dam by reason of its elacticity and this yielding may cause a strain considerably greater than the pressure that caused it. Thus supposing that the pressure against the dam should be increased by a violent flood or earthquake, the dam would then be forced against the abutments and the elasticity of the curved walls would allow a little yielding such that the face would be a little out of the perpendicular. This condition would add to the strain on the slab in question a small percentage of the superimposed dead weight. As this is an indeterminable factor, it is necessary to have an unusually high factor of safety in the face wall.

The following notation and formula are used in computing the water pressure on the slab:

g=center of gravity of outer surface of slab exposed to water pressure.
d=vertical distance from g to water surface, measured in feet=184·5.
A=area of slab exposed to pressure measured in sq. ft.
w=weight of a cubic foot of water in lbs.
L=length between supports in inches=168.
W=total pressure on slab.

In this case

A=14 sq. ft. (The slab is 20 ft. long center to center of buttresses, but only 14 ft. long in the clear.)
D=184.50.
w=62.50 (approximately).

It is evident that

$$W = A \times w \times D = 14 \times 184.50 \times 62.50 = 161{,}437$$

The pressure moment in inch pounds =

$$\frac{W.L}{8} = \frac{161{,}437 \times 168}{8} = 3{,}390{,}177 \text{ inch pounds.}$$

Weight of face wall, central slab =

$$\frac{8 \times 2}{2} \times 184 \times 20 \times 150 = 2{,}760{,}000 \text{ (approximate).}$$

¼ weight of dirt above floor =

$$\frac{17.5 \times 13 \times 110 \times 80}{4} = 500{,}500$$

Total weight = 3,260,500 lbs.

Our beam therefore must stand a pressure of 3,390,177 inch pounds and the foundation for this segment must be strong enough to carry a load of 3,260,000 lbs.

The following are the notations, formulae and respective dimensions used in the formulae to calculate the strength of the face wall as assumed above.

The coefficients have been calculated to correspond to the material used, both with regard to concrete and steel. Concrete will be first class 1-3-5 mixture and steel of good quality. See Webb and Gibson, "Reinforced Concrete," pp. 49 and 50.

Mo=Ultimate resistance moment in inch pounds.
b=breadth of slab transverse to pressure = 12".
d=depth from the face under compression to the center of gravity of the steel reinforcement, in this case = 82" as shown later.
C=compressive strength of concrete in lbs. per sq. in. = 2700 in our case. (Webb and Gibson.)
Ec=Initial modulus of elasticity of concrete = 3,000,000.
Es=Modulus of elasticity of steel = 30,000,000.

$$R = \text{Ratio of Moduli} = \frac{Ec}{Es} = \frac{30{,}000{,}000}{3{,}000{,}000} = 10$$

S=Tensile strength of steel = 55,000 lbs.
p=Percentage of steel =

$$\frac{7\,C^2 R}{12\,S\,(CR + .667\,S)} = \frac{7 \times 2700^2 \times 10}{12 \times 55{,}000\,(2700 \times 10 + .667 \times 55{,}000)} = .0121$$

Webb and Gibson p. 62.

This percentage of steel amounts to 96 × 12 × .0121 = 13.94 sq. in. of steel for each tabular segment 1 ft. thick. This may be done by placing 6 round bars, 1⅛" in diameter, in layers 6" apart and spaced 4" from each other, beginning 4" from the face. This gives a value to "d" of 82".

K=Ratio of depth from compressive face to neutral axis to the total effective depth, "d."
K=From table on page 61, Webb and Gibson, = .424.
Y=Distance from compressive face to center of gravity of compressive stresses.

$$Y = .357\ Kd = .357 \times .424 \times 82 = 12.4$$

(See Webb and Gibson p. 59.)

$$Mo = p\ b\ d\ S\ (d - Y) = .0121 \times 12 \times 82 \times 55{,}000 \times (82 - 12.4 = 48{,}016{,}750.$$

In other words, our slab will withstand a pressure of 48,016,750 inch pounds, and the maximum normal load that can come on it is 3,390,177 inch pounds.

The above calculations show that when the reservoir is full, the face wall has a factor of safety against normal water pressure alone of about 14, considering the face wall as a simple beam supported at both ends, but it is also a cantilever. Owing to the reversal of pressure when the dam is empty the wall must be reinforced on both sides and hence with regard to the buttresses it is both simple beam and cantilever, which doubles the factor of safety, making it 28, and this is disregarding entirely the fact that the face wall is backed up with earth which, in turn, is held in place by all auxiliary walls. It is evident, I think, that so far as the important feature of water pressure is concerned, the face wall is more than amply strong.

It has been suggested that the dirt filling of the cells would act as a liquid in exerting pressure, because this filling will be packed with water. I think this extreme view is unwarranted; nevertheless, it is easy to compare the relative strains of external and internal pressure by assuming such a condition. We have taken 110 lbs. per sq. ft. as the weight of a cubic foot of water-packed earth and rock. The weight of a cubic foot of water is commonly taken at 62·5 lbs. If, then, the earth filling were a liquid, it would exert a pressure greater than that of water in proportion to the relative weights or

$$\frac{110}{62.5} = 1.76$$

The earth column is, however, divided by the sill-floor so that we have 105 feet of earth as against 184.5 ft, of water. The factor safety, then, will vary inversely as the relative height and weights $\frac{105 \times 110}{62.5 \times 184.5} = 1.003.$

In other words, the face wall as designed is equally strong to resist internal or external pressure, even if the earthen filling is regarded as a liquid. It is obvious, however, that the horizontal reinforcing of the buttress must be fastened by tie bars to those of the face wall and be strong enough to prevent parting, so it is planned to hook the horizontal reinforcing bars of the buttress over the horizontal bars of the logitudinal walls.

The next test in order is to ascertain what crushing strain this wall will stand.

Kidder gives the crushing strength of unreinforced concrete (1 part cement, 2 parts sand, 6 parts broken rock), at 440,000 lbs. per square foot. As we have in the bottom slab 20' × 8' = 160 square feet, the resisting strength is 70,400,000 lbs., while, as previously computed, the weight above this slab is only 3,260,500, and so we have a factor of safety of 20 when disregarding the reinforcement.

The face wall is then abundantly strong from all standpoints.

We will now consider the buttresses. These are subjected to two main strains. There is shear strain and pressure exerted by the overturning moment and the direct water pressure. As in this design the resultant of the graphic computation of the overturning moment strikes the base line 1/3 the distance from the toe, it is sometimes assumed that all of the resultant pressure is applied along the imaginary line of the resultant and is met by the resistance of the buttress wall equidistant on both sides of this line. This means that the pressure will gradually increase from face to rear and the extreme rear will bear twice the average pressure. As the buttress is 165 feet long and 3 feet thick at the bottom, we have 165 × 3 = 495 sq. ft. of material in compression and each square foot will stand 440,000 lbs. (not counting the reinforcement), or a total of 217,800,000 lbs. which acts through a moment arm of 110 ft., the product being 23,958,000,000. The water pressure on the panel supported by this buttress is 21,332,720 lbs. (as shown above), which acts through an arm of moment of 61.6 feet, the product being 1,314,067,272, the factor of safety by this method of computation being 17, on the average of 8½ for the rearmost portion. This will be much increased by the reinforcement and by the supplementary resistance of the earth filling

and auxiliary walls. Perhaps a better way to figure the factor of safety of the buttresses is as follows:

The water pressure acts in a horizontal line inducing shear strain. The strength of concrete in shear is one-half what it is in compression.

Owing to the fact that these buttresses are tightly held on both sides by the auxiliary walls and the earth filling, they cannot yield by buckling and if they yield at all, it must be by shear or crushing. We may, therefore, double all the horizontal pressure and add to it all the vertical pressure and if the wall is sufficiently strong in compression it surely will be in shear. When considered in this way, however, it is proper to consider all the material that will be in shear. This includes a segment of the face wall 20 ft. wide, and a similar segment of all the auxiliary walls. There will be a total of 910 sq. ft. of reinforced concrete to resist the shear and pressure. This material, disregarding the reinforcement, is capable of standing a pressure of $910 \times 440{,}000 = 400{,}400{,}000$.

The total pressure is as follows:

Double the water pressure as given above....42,665,400 lbs.
Weight of aux. walls........................ 3,150,000 lbs.
Weight of buttresses........................ 3,073,750 lbs.
Weight of earth above sill-floor............ 2,002,000 lbs.
Weight of face wall......................... 2,760,000 lbs.

55,641,190 lbs.

As the power of resistance is 400,400,000 lbs., and the maximum strain 55,641,190 lbs., it is plain that we have a factor of safety of 7.1, which will be much increased when the reinforcement of the concrete and the resistance of the earth filling are considered.

Thus it will be seen that the lower section of the dam as designed is amply strong. In the same way each section taken at 5, 20 and 40 foot intervals, has been checked and the dam is abundantly strong on each section.

The arched floor is calculated as a horiontal slab which must be able to carry the dirt filling. Taking a 1 ft. segment, the load will be—

$$1 \times 20 \times 80 \times 110 = 176{,}000 \text{ lbs.},$$

and its own weight $= 20 \times 1 \times 1 \times 150 = 3{,}000$.

The total weight upon the slab is 179,000 lbs. With a safety factor of 4, the ultimate load will be

$$4 \times 179{,}000 = 716{,}000 \text{ lbs.}$$

To compute the required thickness of the arched floor, the same notation as above is used.

And from the above formula,

Mo=p b d S (d—Y), we deduce,

Assuming that $P = 1\%$ and $d = 12$, we find from equation (6) Webb and Gibson that $Y = .357$ Kd. From table on page 61 we find $K = 422$, so $Y = .161d$ and $d - x = .849d$.

As $Mo = 716{,}000$ lbs., we obtain

$$d = \frac{\sqrt{.0121 \times 12 \times 55{,}000 \times .849}}{716{,}000} = \frac{\sqrt{716{,}000}}{6780} = \sqrt{118} = 11''$$

The sill-floor, then, will be 1 ft. thick, assuming that the reinforcing is 1" from the surface. It will also be arched to increase its strength.

The reinforcing for each part of the dam has been figured out, as given above for the face wall. Although there was some variation in results it was not sufficient to adopt different percentages for different parts of the dam, and 1% is a good average reinforcement for all parts, but the face wall which will be 1.2% on each side or 2.4% altogether.

From the foregoing calculations, I believe this type of dam is thoroughly strong and safe.

In the particular instance given above, a solid concrete dam will require 300,000 cu. yds. of concrete. The cellular dam will require 300,000 cu. yds. of dirt filling and 50,000 cu. yds. of reinforced concrete.

300,000 cu. yds. concrete at $5.00 = $1,500,000.
300,000 cu. yds. dirt at 20c = $60,000.
50,000 cu. yds. reinforced
concrete at $12.00 = $600,000.
Total $660,000

While the above figures would vary with each individual case, it can readily be seen that there is great economy in the use of this dam, if no unforseen conditions may arise which render it inapplicable. I shall welcome criticisms of the structure.

Mr. W. A. Homan, of my office, assisted me in working out the design.

The computations were then gone over and checked by Mr. J. E. Payne, engineer for the Corrugated Bar Company of St. Louis. Mr. Payne's great experience in reinforced concrete enabled him to make some valuable suggestions which were adopted.

A great many power and irrigation projects come to my attention, and to the attention of other engineers, which would be very desirable indeed were it not for the great expense of building a thoroughly substantial dam. This is particularly true with regard to projects involving the use of mountain meadows for reservoir sites. In such instances it is generally unwise to use an earthen dam because of the violent floods which characterize the mountain streams and a masonry or monolithic concrete dam is so expensive that the project is impracticable. It is most important to the Rocky Mountain States that the storing of water be made as cheap as possible. The most efficient way to use our waters is to develop power in the mountain canons and then use the water for irrigation on the plains and valleys below. To do this requires double storage. The power user wants water in a continuous and regulated flow the year round. The farmer wants all his water during three months in the summer. Nature, on the other hand, pleases neither the power man nor the farmer, for she furnishes a flow which varies from year to year and season to season. It will readily be seen, I think, what a very important matter it is if a good dam can be built at half the present cost of masonry dam construction.

LARGER AREA OF LAND LEFT OPEN IN COLORADO THAN IN OTHER STATES, BARRING TWO.

The annual report of the United States land office, just issued, gives to this state 19,432,000 acres of surveyed lands not homesteaded, a larger area than that left open in any commonwealth in the union, barring Wyoming and Nevada. This land, according to the officers of the land department in Denver, does not include any within the forest reserves.

The total acreage, surveyed and unsurveyed in the state, is 21,726,192. A majority of this land is fine for agricultural purposes, though much of it is of a mountainous, grazing or mineral nature.

In the Denver district alone, including the counties of Adams, Arapahoe, Boulder, Clear Creek, Douglas, Eagle, Elbert, Gilpin, Grand, Jackson, Jefferson, Larimer, Morgan, Routt, Summit and Weld, there is a total of 1,237,040 acres of surveyed lands.

The largest district in the state is the Glenwood Springs section, with 4,593,668 acres. This district contains Routt county, with 1,869,036 acres. Las Animas county, in the Pueblo district, has 1,521,524 acres.

Del Norte district contains 644,433 acres; Durango, 982,170; Montrose, 3,946,703; Pueblo, 4,106,118; Hugo, 124,530; Lamar, 2,170,640; Leadville, 534,073; Sterling, 1,092,634.

Those interested in securing government lands should have a copy of "The Settler's Hand Book," which contains maps showing the location of the different lands and just the information that the homeseeker requires. These books can be had from *Ranch and Range*.

ANOTHER IRRIGATION ENTERPRISE FOR COLORADO.

The neighborhood of Pueblo is to be the scene of effort of another large irrigation concern. The new concern has filed incorporation papers here, the capital being given at $50,000, which is 50,000 shares of stock at $1 each.

However, it is understood that this is only the preliminary capitalization, and that the company will later increase its capital to a considerable extent. The incorporators are L. A. May, E. T. May, Denver; and Kurt Grunwald, formerly of Pueblo, but now of Denver.

Four large reservoirs are planned by the new concern, the water supply to be derived from the flood waters of the Fountain river and the Chico creek. The land is located northeast of Pueblo and consists of approximately 25,000 acres. The directors of the company are E. T. May, L. A. May, Kurt Grunwald, R. W. Rose and H. S. Hopkins. Their attorney is former Attorney General John T. Barnett.

The principal office will be in Pueblo, and it is expected that this office will be opened in the near future. A branch office will be maintained in Denver.

THE PRIMER OF HYDRAULICS*

By FREDERICK A. SMITH, C. E.

Article VI. Mensuration of Solids.

1. *Prisms.*

A prism is a solid bounded by 2 parallel polygons as end surfaces and parallelograms as sides; if the end surfaces are parallelograms the solid is called a parallelopiped,, and if it is bounded by 6 rectangles then it is called a right parallelopiped, and if in such a solid all faces are squares it is called a cube. Thus Fig. 46 represents a cube and if $AB = 1$ ft. the volume of the solid is called 1 cubic ft.; if $AB = 1$ inch the solid is called one cubic inch, etc. Such a cube is used as an unit to measure the volume of the other solids with.

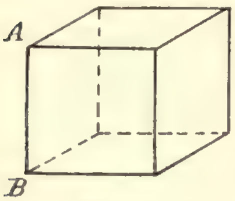


Fig. 46

The volume of a prism is found by multiplying the area of the base by the perpendicular height; the height is to be taken perpendicular between the two end surfaces. Thus in Fig. 47 the two prisms I and II contain the same volume if the bases have the same area and the heights are equal; observe the height in Prism II to be the perpendicular distance between the end surfaces.

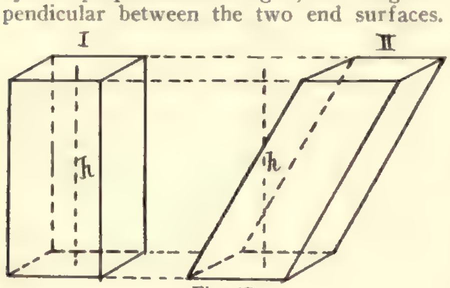


Fig. 47

Problem. Find the volume of a rectangular prism with a base $3' \times 4'$ and a height of 5 ft. (Fig. 47-I.)

Solution. Let V = volume, then $V = 3 \times 4 \times 5 = 60$ cub. ft.

The surface consists of 6 rectangles, 2 end rectangles.

each $3' \times 4'$, or 12 sq. ft. each	=	24 sq. ft.
4 sides, each $4' \times 5'$, or 20 sq. ft. each	=	80 sq. ft.
Total area in surface,		104 sq. ft.

2. *Pyramids.*

A pyramid is a solid having a plane polygon for its base and is bounded by as many triangles as the base has sides, all having a common vertex P; thus in Fig. 48 let A, B, C, D, E, be the base and P the vertex of the pyramid, then the base is a pentagon, and the other surfaces are 5 triangles with the point P in common; if a perpendicular is drawn from P to the base like $P\ H$, then $P\ H$ is called the height of the pyramid.

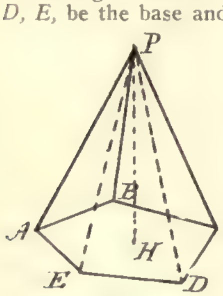


Fig. 48

Rule. The volume of a pyramid is found by multiplying the area of the base by the height and divide by 3. The area of the surfaces bounding a pyramid consists of the sum of the area of the base plus the areas of the triangles; thus in Fig. 48 the surface of the pyramid is equal to area of the pentagon $A\ B\ C\ D\ E$ plus the 5 triangles, $A\ P\ B + B\ P\ C + C\ P, D + D\ P\ E + E\ P\ A$

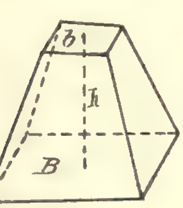


Fig. 49

If the top is cut away from a pyramid like in Fig. 49, it is called a frustum of a pyramid—if the area of the base $= B$ and the area of the top $= C$ and the height h (distance between top and bottom), then the volume of the frustum $V = \frac{h}{3} (B + C + \sqrt{B\ C})$.

3. *Prismoids.*

In Fig. 50 is shown a solid known as a prismoid; it is a solid bounded by two parallel end surfaces and the sides are formed by trapezoids. The perpendicular distance h between the top surface B and the bottom surface A, Fig. 50, is called the height of the prismoid; if a section M is taken through the solid, midway between the two end surfaces, then the volume V of the solid is found by the following formula:

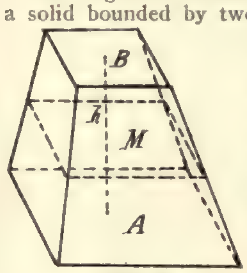


Fig. 50

$V = \frac{h}{6} (A + 4\ M + B)$, which expressed in words reads: The volume of a prismoid is found by adding 4 times the area of the middle section to the sum of the top and bottom surface and multiply by 1/6 of the height.

Application. In Fig. 50, let A be a rectangle 3×5 ft., B a rectangle 2×4 ft., and let $h = 9$ ft.; find volume of prismoid.

Solution. The area of $A = 3 \times 5 = 15$; the area of $B = 2 \times 4 = 8$; the sides of the rectangle M are $\frac{3+2}{2}$ and $\frac{5+4}{2}$ $= 2.5$ and 4.5 respectively; hence $M = 11.25$ and $4\ M = 45$; apply now formula $V = \frac{h}{6} (A + 4\ M + B.)$

$V = \frac{9}{6} (15 + 45 + 8) = 1.5 \times 68 = 102$ cub. ft. The surface of such a solid is equal to the sum of surfaces of the bounding side; thus let S = the surface of the prismoid just considered, then $S = A + B + 2C + 2D$; where C and D respectively are the trapezoidal sides; care must be taken in figuring the surfaces not to confound the slant height of the trapezoids with the vertical height of the body.

4. *Cylinders.*

To find the volume of a cylinder multiply the area of the base by the height, because a cylinder can be considered a prism of a very large number of sides and therefore the volume of the cylinder is found by multiplying the area of base by height, just like the prism. When the two bases of a cylinder are circles with the centers perpendicular above each other, as shown in Fig. 51, it is called a right cylinder, and the line OO' is called the axis or height of the cylinder; if the radius of the cylinder is r and the height h, then $V = \pi r^2 h$.

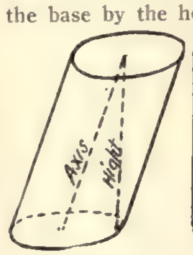


Fig. 52

Fig. 51

The surface of the cylinder consists of the two end circles $= \pi r^2$ plus the shell, which is a rectangle h ft. high and the width of which is $2 \pi r$, hence $S = 2 \pi r^2 + 2 \pi r h$, which can be simplified to: $S = 2 \pi r (r + h)$; this can be expressed in words: The surface of a right cylinder is equal to the sum of radius and height multiplied by the circumference. To apply to a problem let the radius of a cylinder be 3 ft. and the height 5 ft.; find volume and surface.

$V = 3.1416 \times 3 \times 3 \times 5 = 141.372$ cub. ft.

$S = 2 \times 3.1416 \times 3 \times 8 = 6.2832 \times 24 = 150.81$ sq. ft.

Cylinders may be oblique, as shown in Fig. 52; then the height must be perpendicular to the two end surfaces for the figuring of the volume, but parallel to axis when figuring the area of surface.

5. *Cones.*

A cone, shown in Fig. 53, may be considered as a pyramid with a large number of sides; it has a base A which is a plane surface from which innumerable triangles reach to a common point V, called the vertex. A line VV', drawn perpendicular from the vertex to base is called the height of the cone; if the base A is a circle and VV' strikes its center it is called a right circular cone. The volume of such a cone is found as follows: $V = \frac{\pi r^2 h}{3}$ and the surface S

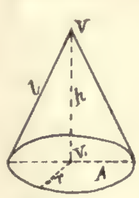


Fig. 53

*Copyright by D. H. Anderson.

consists of the base πr^2 plus the shell, which is a sector of a circle having a radius l and spans an arc $= 2 \pi r$, hence: $S = \pi r^2 + \pi r l = \pi r (r + l.)$

Problem. Find the volume and surface of a right circular cone when $h = 7$ ft. and $r = 2$ ft.

Solution. $V = \frac{\pi r^2 h}{3} = \frac{3.1416 \times 2 \times 2 \times 7}{3} = 29.321$ cub. ft.; for S first find $l = \sqrt{r^2 + h^2} = \sqrt{4 + 49} = \sqrt{53} = 7.283$, then $S = 3.1416 \times 2\ (2 + 7.283) = 58.327$ sq. ft.

The frustum of a cone will be handled like that of a pyramid, thus for a right circular cone: when R and r are the radius of the base and top and h the height:

$V = \frac{h}{3} (\pi R^2 + \pi r^2 + \sqrt{\pi R^2 \times \pi r^2})$, which can be simplified:

$$V = \frac{h \pi}{3} (R^2 + r^2 + R\, r.)$$

Problem. Find volume of a frustum of a cone, if $R = 4$ ft., $r = 3$ ft. and $h = 5$ ft.

Solution. $V = \frac{5 \times 3.1416}{3} (5 \times 5 + 3 \times 3 + 5 \times 3.)$

$$V = \frac{5 \times 3.1416 \times 49}{3} = 256.564 \text{ cub. ft.}$$

6. *Sphere.*

A sphere is a solid, uniformly rounded so that each point in the surface has the same distance from a point within called the center; the distance from center to surface is called the radius. Every section made through a sphere forms a circle; when such a section passes through the center of the sphere it is called a great circle having a radius = to radius of sphere. The surface area of a sphere is equal to 4 times a great circle, thus if r = radius of sphere, then $S = 4 \pi r^2$.

The volume of the sphere may be considered as the sum of myriads of cones having their bases in the surface of the sphere and their vertices in its center, and as the volume of a cone is equal to base times 1/3 of height the volume of the sphere will be equal to the area of its surface multiplied by 1/3 of the radius, or $V = 4 \pi r^2 \times \frac{r}{3} = \frac{4}{3} \pi r^3$.

Example. Find the surface and volume of a sphere having a radius of 8 ft.

Solution. $S = 4 \pi r^2 = 4 \times 3.1416 \times 8 \times 8 = 804.25$ sq. ft.

$$V = \frac{4 \pi r^3}{3} = \frac{4 \times 3.1416 \times 8 \times 8 \times 8}{3} = 2144.94 \text{ cub. ft.}$$

If in a cylinder the height $= 2r$, its cross section becomes a square, Fig. 54; a circle of the radius r could be inscribed in it and represents the cross section of a sphere of the radius r, and the triangle shown represents a right cone having the same base and height as the cylinder; the relation of the volumes of these 3 bodies is as 1/3, 2/3, and 3/3, the cone being 1/3, the sphere 2/3 and the cylinder 3/3 of the whole, thus: Cylinder $= 2 \pi r^3$, sphere ...... $\frac{4 \pi r^3}{3}$ and the cone $= \frac{2 \pi r^3}{3}$

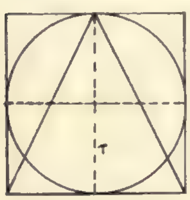


Fig. 54

It is understood that work on the irrigation project between Camp Crooks, South Dakota, and Alzada, Mont., on the Little Missouri river, by which 20,000 acres of desert land will be reclaimed, will be started this month.

In the city of Chicago the government of the United States has established an office in charge of a gentleman of the name of Carpenter, whose business it is to furnish information to anyone who desires to know something of irrigated lands. The full address is here given: C. F. Carpenter, Settlement Agent, U. S. Reclamation Service 802 Federal Building, Chicago.

Supreme Court Decisions

Irrigation Cases

POINT OF DIVERSION—

Where defendant was entitled to take water from plaintiff's ditch for irrigating purposes, it was immaterial at what point upon the ditch defendant chose to divert the water, though, if he selected one point for diverting it, he could not thereafter select another point. *Redwater Land & Canal Co.* v. *Jones.* Supreme Court of South Dakota.. 130 Northwestern 85.

APPROPRIATORS—

Nonuser by an upper proprietor or appropriator of water is not available to strengthen a lower appropriator's claim by prescription, where such lower appropriator is not a riparian owner, but takes the water for use on nonriparian lands. *Perry* v. *Calkins.* Supreme Court of California. 113 Pacific 136.

APPROPRIATION—

The bona fide intention which is required of an appropriator to apply water to some useful purpose may comprehend a use to be made by or through another person, and upon lands and possessions other than those of the appropriator. *Nevada Ditch Co.* v. *Canyon & Sand Hollow Ditch Co.* Supreme Court of Oregon. 114 Pacific 86.

TRESPASS ON IRRIGATION DITCH—

Where an abutting owner used land within a highway, outside of the traveled portion, for the maintenance of irrigation ditches in such a way as not to interfere with the public use, any interference with such ditches by a third person constituted a trespass. *Holm* v. *Montgomery.* Supreme Court of Washington. 113 Pacific 1115.

ABANDONMENT OF WATER RIGHTS—

Where, to convey water of an appropriator, it was necessary to construct and maintain a flume across a ravine, and the flume broke down, the act of the appropriator in turning water into a ditch from year to year to preserve his right, and in subsequently conveying an interest therein, was admissible to negative any intention to abandon his water rights at the time the flume broke down, or subsequently. *Featherman* v. *Hennessey.* Supreme Court of Montana. 113 Pacific 751.

PARTIES TO SUIT ON APPROPRIATION—

An appropriator of water from a stream is a proper party to a suit affecting the right of appropriation of the waters of such stream: but such person is not an indispensable party, and a judgment rendered in said cause would be just as effective as to the rights and interest of all those who were parties to said action, as between themselves, and whose rights have been adjudicated, as though such other person had also been made a party. *Fost* v. *Idaho Irrigation Co., Limited.* Supreme Court of Idaho. 114 Pacific 38.

PRESCRIPTIVE RIGHT TO OVERFLOW LAND OF ANOTHER—

To acquire a prescriptive right to overflow the land of another, there must have been an uninterrupted enjoyment under claim of right for five years, and there must have been an actual occupation by the flow of water, to the knowledge of the owner of the land, and such as to occasion damage and give him a right of action, and there must have been such a use of land and such damage as will raise a presumption that he would not have submitted to it unless a right existed. *Galbreath* v. *Hopkins.* Supreme Court of California. 113 Pacific 174.

TAXATION OF WATER RIGHTS—

Where an irrigation company which owned no land contracted to sell the water rights therein to abutting owners upon condition that, when all the rights were sold, the purchasers would own the ditch, but sold only a part of the water rights, those remaining were not appurtenant to land, but were separate property, and taxable under Comp. St. 1910, § 2330, providing that the property of companies constructing or owning canals, ditches, or flumes shall be assessed. *Wyoming Central Irr. Co.* v. *Farlow County Treasurer.* Supreme Court of Wyoming. 114 Pacific 635.

ESTABLISHMENT OF IRRIGATION DISTRICTS—

Under the following provision of section 2377, Rev. Codes, to wit: "No action shall be commenced or maintained, or

(Continued on page 906.)

Notes on Practical Irrigation

D. H. Anderson

The Use of Wells, Streams, Ditches and Reservoirs to Dispose of the Tremendous Supply of Water.

Statistics show that the mean annual rainfall of the world is thirty-six inches, which is about 50,000,000 cubic feet per square mile of the earth's surface per annum, a quantity of water which is amazing when reduced to gallons so as to bring it more readily within the average comprehension.

A gallon of water, United States standard, weighs eight and one-third pounds, and contains 231 cubic inches. As there are 1.728 cubic inches in a cubic foot, a simple calculation will show that the annual rainfall on every tract of land equal to 640 acres amounts to 374,026,000 gallons, or, reducing it to weight, 1,558,442 tons of water, being about 2,435 tons per acre. It will, of course, be understood that all this water is not equally distributed, but it all falls upon the earth somewhere and is taken up by the soil in the same proportionate amount as by the oceans and seas. The calculation might be made more accurate by assuming that the surface of the earth is about one-third land and two-thirds water, and that, therefore, only one-third of this enormous quantity of water is taken up by the land, but we are dealing with averages and the record must stand as written.

This tremendous supply of water must be disposed of by nature in some adequate manner, for if allowed to stand and accumulate the earth would soon be submerged. Fortunately, Dame Nature disposes of it, except when an inundation somewhere sweeps away towns and country, showing that she herself is overburdened with the supply. The rain falls and is carried off the land so far as the surplus that is not drunk in by the every thirsty soil is concerned, by means of brooks, rivulets, streams, rivers and mighty waterways into the ocean for transformation by evaporation into more rain. A large portion of it remaining on the land also evaporates, that is, transformed into vapor, which hangs in the atmosphere, invisible except to touch, when the weather is "damp," as is said, or gathers into clouds which empty their contents back upon the earth. So far, the action of evaporation and rainfall is equal and the equilibrium or eternal balance of nature is maintained.

Surface Water.

But an enormous portion of the fallen rain does not return into the atmosphere, whence it came, to repeat its beneficial and grateful performance; it penetrates into the soil, percolates through a myriad of pores, cracks and crannies, until it accumulates beneath the surface of the earth, sometimes at immense depths, and forms subterranean streams and reservoirs. Sometimes, when the soil is unyielding, the percolating water does not attain the dignity of a subterranean stream or reservoir, but is held in the grasp of the soil above some impervious or impenetrable stratum of rock or hard pan, and becomes what is known as "surface water," a water table which throws off moisture to be carried to the surface by capillary attraction.

It is a maxim in physics, "nature abhors a vacuum," and so whenever there is a vacant place the water fills it, and thus there is a never ending supply of water from rain or melting snow which is practically rain in another form. The fact that there are rainless, arid regions does not alter the fact, for somewhere beyond them in the mountains is the supply of water the rainless belt should receive, and it sinks beneath the arid lands waiting to be drawn up to the surface by the ingenuity of man, it being prevented from doing so of its own accord by insurmountable obstacles in the soil.

The method of reaching these subterranean deposits of water, underground reservoirs and water tables, is by what is commonly called "a well." When a well is dug down into the water table or surface water, say from four to six feet in diameter or any other size deemed adequate to insure a good supply of water, and from ten to 100 feet in depth, and curbed with stone or mitred plank, and a windlass and bucket arranged at the top, or a common suction pump, a certain amount of water supply is assured. For domestic purposes, perhaps to irrigate a small garden patch, where labor is of little consideration, a well with the above pumping apparatus will serve, but few farmers will rest content with this ancient system of procuring a water supply, and if anyone aspires to cultivate the soil and irrigate he must largely extend his plant.

Quantity of Water Needed.

To estimate the quantity of water that the irrigation farmer must provide, it is necessary to go into a few details as to the quantity required to raise a crop. That quantity he must have or go out of business.

To irrigate a few acres successfully it may be necessary to have a supply of water running up into the hundreds of thousands of gallons. Taking rainfall as the standard of water needed to grow a crop, we find that one inch of rain on an acre of ground is equivalent to 27,154 gallons, and for the purpose of irrigation, that is, to give the ground a good wetting, at least two inches of water are necessary, more being required in some localities.

Professor King has made the following estimate of the quantity of water required during the growing season in various localities:

Wisconsin	34 inches per acre
California	7½ to 20 inches per acre
Colorado	22 inches per acre
India	48 inches per acre
France and Italy	50 inches per acre

To still further go into the details of the quantity of water required to grow a crop to maturity, Professor King gives the following table of amounts of water necessary to produce the certain plants dry:

	Pounds of Water to Each Pound Dry Product.
Dent corn	309
Flint corn	233
Red clover	452
Barley	392
Oats	559
Field peas	477
Potatoes	422
Rye	353

This enormous quantity of water which must be provided for the needs of plants is not an alarming amount when it is considered that it may be obtained very cheaply by modern machinery where the water supply is adequate and a proper arrangement of ditches and reservoirs is made to economize it, the universal tendency being always toward waste.

Where Open Wells Are a Success.

Ordinary open wells are more successful in clay and stone than in sand, there being far less liability of the water running out, the bottom of the well being a retaining reservoir, which may be greatly enlarged by tunneling out to any safe distance into the water table or water stratum. Where the water stratum is in sand it is better to use screen points, that is, tubing with perforated ends, which admit the water but keep out the sand. Several of these screen points may be run down into the water-bearing sand stratum at a sufficient distance to prevent one robbing the other, and all be connected with a suction pipe. Experience tells that these screens should be run down to the bottom of the water-carrying sand if possible, and that in any event they should be sized according to the depth of the strata.

To accomplish this purpose successfully in wells an open well large enough for two men to work in should be sunk down to the sand and curbed to prevent caving. Then by driving ordinary gas piping as a casing for the screens and boring with a common auger, the screens may be lowered to any depth, or if the water-bearing sand is very deep a succession of screens may be put down on top of each other to enlarge the water supply.

Assuming the water supply to be adequate for the purposes of reasonable irrigation from a well, the next

question is how to raise the water in the most economical manner. Economy is wealth in irrigation more than in any other business. Horace Greeley boasted that he raised the finest potatoes in the country, but they cost him about $2.50 each, and his milk cost him the same price as the finest imported champagne wine.

(To be continued)

WATER POWER OF THE CASCADE RANGE.

The perfection of methods for transmitting electric power over long distances—200 or even 300 miles—which has been attained during the last few years, and the reported rapidity with which water-power properties all over the United States are being acquired by corporations and individuals have brought sharply to public attention the great asset which the people of the country have in the undeveloped water powers of the public domain.

No area in the United States, it is believed by engineers, presents more favorable opportunities for the development of water power than that traversed by the Cascade range, a large proportion of which is still owned by the government. The general elevation of the summit of this great plateau is from 6,000 to 8,000 feet, and many of its lofty peaks extend into the region of eternal snow. Among these peaks are Mount Baker, Mount Rainier, Mount Jefferson, and Mount Shasta, all over 10,000 feet and two of them between 14,000 and 15,000 feet high. The streams draining the Cascade range have steep slopes and are fed during the low-water period by the many snowbanks and glaciers that mantle the high peaks or by the liberal supplies of ground water that exist in this region. The precipitation on the area is abundant, although its distribution is by no means uniform. The streams possess the features requisite for water-power development—rapid fall, abundant water, and comparative uniformity of flow—and the almost unlimited resources of timber, mines, and soil, as yet hardly touched, afford a promising market for these water powers and fix for them a high potential value.

The United States Geological Survey recently published, as Water Supply Paper 253, a report on the water powers of the Cascade Range in southern Washington, by John C. Stevens. This is the first of a proposed series to be issued, one each year, dealing with the water powers of the streams flowing from the Cascade Range in Washington and Oregon. The evident interest in the subject of the report resulted in the almost immediate exhaustion of the edition, and it has just been reprinted and can now be obtained by application to the Director of the Survey at Washington.

The streams considered in this report are Klickitat, White Salmon, Little White Salmon, Lewis, and Toutle rivers, and other streams in the drainage basins of these rivers, all of which were surveyed under the direction of Mr. Stevens by engineers employed by the United States Geological Survey and by the State of Washington, acting in cooperation.

These streams are all tributaries of the Columbia. The most important of them, considered as a source of power, is Klickitat River, which will furnish 154,000 horsepower at low water. The survey of the Klickitat covered 73 miles and included a total fall of 3,255 feet. The White Salmon, Lewis, Toutle, and Little White Salmon take rank as sources of water power in the order named.

The entire system of streams surveyed will afford about 395,000 horsepower. The total water power available in the Columbia River Basin has been estimated at 10,500,000 horsepower, so that the region covered by this first report will furnish only 4 per cent of the enormous aggregate, yet even this small percentage is five times the amount of water power already developed in the State of Washington.

The report contains descriptions of the rivers named and of their important tributaries, with tables showing stream discharge, the result of an extensive system of stream measurements, location of water power sites, and the amount of power available at each site, annual mean and minimum discharge of representative streams of the northwest Pacific coast, and rainfall at numerous places in Washington and Oregon, also a summary of the water laws of Washington.

A valuable portion of the report is a series of plans and profiles showing the course and gradient of each stream surveyed.

PUMPING WATER FOR IRRIGATION IN DELTA COUNTY, COLO.

By C. A. Merrill.

Information has come to us from a Delta, Colo., paper and confirmed by the Delta County Business Men's Association, telling of the advent of a new method of irrigation, so far as Delta county is concerned.

The plant is known as The Orchard Park Power and Irrigation Company. It is located about seven miles west of Delta on the north bank of the Gunnison river. The plant has been running during the fall of 1910 and its success exceeds the expectations of those most interested in it. This system of irrigation is by no means in the experimental stage, but has been in use for some time in the Grand Valley of Colorado and other parts of the country.

The plant consists of a 48-inch turbine water wheel in connection with three stage pumps, and as it now stands will irrigate 400 acres of land, the water being lifted to a height of 200 feet. Water is taken from the Gunnison river through a large canal, a little over one mile in length and about 50 feet wide to site of the plant, where it falls through the turbine wheel and furnishes power to lift water to the mesa above.

By installing additional machinery this water system can readily be increased to irrigate the 2,000 acres of fine land that comes under it, and at very little additional expense, as the plant was constructed with a view of its enlargement.

Practically all of the land is a red sandy soil and is known as typical mesa fruit soil. Considerable land has already been fenced and sowed to fall wheat, and this entire tract will soon become green fields and beautiful orchards, the homes of a happy and contented people, in place of a barren waste.

These lands are favorably located close to Delta. They are within one-half to one and one-half miles of the Denver & Rio Grande Railroad, and the state highway between Delta and Grand Junction also passes through this tract.

It is the plan to dispose of part of the land in order to raise sufficient money to enlarge the plant to irrigate the 2,000 acres. While the plant has been put in to reclaim and irrigate the fine fruit land in that vicinity, it is quite likely as its capacity is increased, power will be developed and sold for other purposes.

It is claimed the yearly maintenance of this new irrigation system will be considerably less than a great number of reservoir and gravity systems now in use, the power being the cheapest kind of power and supply unlimited, and no long ditches to maintain. When enlarged, the revenue derived from the sale of power for other purposes than irrigation will more than cover the maintenance expense.

As additional land is put under cultivation it is probable a new town will be established.

At the Colorado State Fair held this fall in Pueblo, Delta county received the following premiums on fruit: Thirty-ninety first prizes, 27 second and 20 third. And at the National Irrigation Congress the Guggenheim cup for the best display of fruit was captured. Delta county is noted as one of the leading fruit districts.

The sign of prosperity and progress is seen on every hand in both city and country. The city of Delta has population of 3,000. It is the county seat. During this autumn the public buildings and business blocks constructed, or in the course of construction, in the city, aggregate $200,000; and this does not include the many fine residences building throughout the city. The city's domestic water is unsurpassed, being pure mountain water piped into the city, and school facilities are of the very best.

The Deerings of Chicago, formerly prominent as manufacturers of harvesting machinery, have recently invested in 24,000 acres of land in California, which was acquired through D. W. Ross, at one time in charge of the Minnidoka project in Idaho, and Thomas H. Means, who was soil expert for the Department of Agriculture and later in charge of the Truckee-Carson project. The consideration is said to be approximately $1,000,000.

It would seem from the above that some of the reclamation officials have had their eyes open during their term of service and have not been sleeping since that time.

(Continued from 903)

defense made affecting the validity of such organization after two years from and after making and entering said order" (the order referred to being the one made by the board of county commissioners declaring the due organization of an irrigation district)—the time is limited to two years in which any action may be commenced or maintained, or defense made, affecting the validity of the organization of such district. *Progressive Irr. Dist.* v. *Anderson.* Supreme Court of Idaho. 114 Pacific 16.

Unappropriated Water—

Where a lake contained unappropriated water more than sufficient to supply an appropriation applied for by defendants in addition to the water applied to a beneficial use by prior appropriators, defendants were entitled to the granting of their appropriation, though the withdrawal of the water they required might necessitate a change in the methods or means used by the prior appropriators to withdraw the water to which they were entitled so as to permit the use of the surplus and unappropriated water by defendants. *Salt Lake City* v. *Gardner.* Supreme Court of Utah. 114 Pacific 147.

Rights of Appropriation—

In an action for damages for diverting water from an irrigating ditch, an instruction that if by opening the bottom of a dam in a box, whereby the water could run through to plaintiff, and, if by turning in enough water additional at the head of the ditch in N. P. river, he could have procured a sufficient volume of water to have satisfied his needs, and thus avoided any injury to plaintiff, it was defendant's duty to have done so, was not erroneous, where the evidence showed that there was an abundant supply of water at the head of the ditch for all parties interested. *Dalton* v. *Kelsey.* Supreme Court of Oregon. 114 Pacific 464.

Reservoir Permits—

The primary reservoir permit, provided for by act Feb. 24, 109, known as the "Water Code" (Laws 1909, p. 337) § 58, does not include the right to divert and use such stored water, but contemplates only a storage of the water in some locality where it can be utilized for irrigation; while the secondary permit provided for thereby contemplates that a user of the water shall acquire a permanent ownership by agreement with the owner for a specific quantity of the stored water for the needs of the use on his land, and when reclamation of the land is completed the water becomes appurtenant to his land. *Cookinham* v. *Lewis.* Supreme Court of Oregon. 114 Pacific 88.

Water a Property Right—

This section of the Constitution declares that an appropriation of water to a beneficial use is a constitutional right, and that the first in time is the first in right, without reference to the particular use, and clearly recognizes an appropriation for domestic use as superior to appropriations for other uses, when the waters of any natural stream are not sufficient for all those desiring the same; and that the right to use water for a beneficial purpose is a property right, subject to such provisions of law regulating the taking of private property for public and private use as referred to in section 14, art. 1, of the Constitution. *Montpelier Milling Co.* v. *City of Montpelier.* Supreme Court of Idaho. 113 Pacific 741.

Diversion of Water—

The plaintiff complained that the defendant had taken forcible possession of its dam, by means of which and a connected canal it had undertaken to supply and was supplying water from the Rio Hondo for irrigating crops, then growing, to a large number of farmers, who were dependent on it for water; that the defendant was taking water from its reservoir for his own use by removing flashboards from its said dam, so as to allow the water to flow down to his land on said stream, and that its business of supplying water, as aforesaid, would be irreparably injured by the acts of the defendant, if they should be continued. *Held,* that the matter was properly cognizable in a court of equity; that a preliminary injunction, and, after trial, a permanent injunction, were properly issued against the defendant. *Hagerman Irrigation Co.* v. *McMurry.* Supreme Court of New Mexico. 113 Pacific 823.

Surface Water—

In the winter and early spring months flood waters gather from time to time in several draws or basins above respondent's lands and flow down across appellant's canal, and over and upon the lands of the respondent, in large volumes. The irrigation district, in order to prevent these flood waters washing out the banks of its canal and breaking down the canal, built a spillway 16 feet wide in the bank of the canal on the lower side, and, when the flood waters come, opens the spillway and allows the entire volume of water to run through and upon the lands of respondent. It appears that in the natural flow of water down these draws and drainage basins, it runs in several channels and spreads out over the lands of the respondent. *Held,* that the irrigation district cannot collect the waters and pour them out through one spillway in one volume onto the lands of the respondent so as to increase the damage done to his lands, but that, on the contrary, the district must, if it desires to collect the waters and turn them through spillways, so distribute the waters as to allow them to flow over the respondent's land in as nearly the same manner and proportion as they would in their natural state, and in such manner as to do no greater damage than they would inflict on respondent in their usual and ordinary flow. *Teeter* v. *Nampa & Meridian Irr. Dist.* Supreme Court of Idaho. 114 Pacific 8.

THE CULTIVATION OF CABBAGE.

The home gardener, the market gardener and the truck farmer, each of whom contributes largely to the vegetable supply, is more or less interested in the growing of one of the most universally cultivated plants—the cabbage; and with its usual sensitiveness to the needs of its clientele the United States Department of Agriculture has recently issued a bulletin (Farmers' Bulletin No. 433) describing its cultivation under the different requirements of those three environments.

Although one of the coarser vegetables, cabbage finds a place in the home garden as well as in the market garden and the truck farm, and in some sections of the United States it is extensively grown as a farm crop. No adequate estimate, however, can be placed on the value of this crop, as it fluctuates very decidedly from year to year both in acreage and price; but the output is large—the three states of New York, Pennsylvania and Virginia, which outrank all the others, grow commercially about 50,000 acres of this vegetable, either as a spring or autumn crop, in addition to the home-garden supply, which is consumed at home.

Early cabbage is practically all consumed as a green vegetable; the late crop, on the other hand, is handled as a fresh vegetable, as a storage crop, and for the manufacture of sauerkraut. Cabbage is always in demand, and, under present conditions, is always on the market, either in the spring as the product of the southern farm, in the fall and early winter from the northern farm and market garden, or in the winter from the storage house where the surplus has been preserved for this demand.

A section of this bulletin is devoted to each of the three methods of producing the crop commercially—truck crop, market garden crop, and farm crop—and the influence of climate, extent of production, soil, fertilizer, seed, method of producing young plants, varieties, cultivation, enemies, harvesting and marketing, is described and explained under each head, in accordance with the light and knowledge gained from experiments and experience.

THE FRUIT-GROWER'S GUIDE-BOOK.

By E. H. Favor. Published by The Fruit-Grower. Price $1.

This book is designed as a means of assisting many persons who are undertaking the growing of fruit on a commercial scale, yet who feel the need of specific information on many orcharding problems. It is of interest to both the amateur and professsional fruit-grower, and is written in a clear, easy style.

It contains in condensed form the cream of the important facts of orcharding; contains 285 pages and is splendidly illustrated.

The book may be ordered through The Irrigation Age, and will be sent postpaid on receipt of price.

CHANGE IN ORGANIZATION.

Jas. A. Green & Co., Inc., beg to announce that they have taken over the engineering and construction business formerly conducted by Mr. Jas. A. Green, with offices at 226 South La Salle Street, Chicago, and 509 Overland bldg., Boise, Idaho. The company will continue in the general engineering and construction line, paying particular attention to irrigation and hydraulic work.

CORRESPONDENCE

AN IRRIGATION PROBLEM.

Editor Irrigation Age:

I want you to please assist me if you will in regard to a plan we wish to carry out in regard to irrigation, see accompanying drawing. We have ordered a six horsepower engine and a centrifugal pump with a capacity of 185 gallons per minute. Tell us how to apply it to field. We want to use as little pipe as possible so we will ditch *A, C* and *D*, if you think best. If we ditch those lines how far apart should they be placed. If you can think of a better way please tell us.

As to the soil. It is 8 to 12 in. deep, under which is a tough clay that holds water like a jug.

We wish to raise potatoes, cabbage, beans, etc. How many acres can we irrigate per day with the outfit above named? We were expecting 2 to 3 acres per day.

Yours truly,

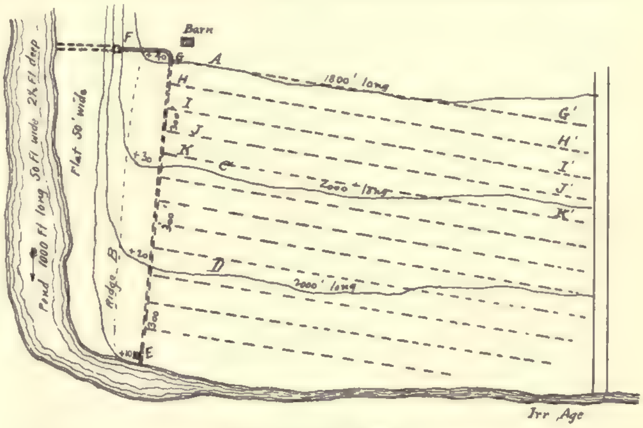
J. F. D.

P. S.—Herewith is a complete drawing of a 45-acre field. We want to irrigate this season between line *D* and creek, containing from 12 to 15 acres. The soil is dark and reaches 10 to 15 inches down; clay or light soil is 10 to 15 inches under ground.

The problem is outlined in the accompanying diagram showing the land surrounded by water on 2 sides. The contour line *A* is 40 ft. above the surface of the water, line *C* is 30 ft., line *D* is 20 ft. above the water level. At point *E* it is proposed to install a centrifugal pump raising 185 gals. of water per min.; the lines *A, C* and *D* divide the land in about 3 equal parts of 12 to 15 acres each; a pipe line along the ridge *B* would be about 900 ft. long, and if the pump at *E* was to supply water for the level at *A* it would have to overcome not only the 40 ft. lift but also the resistance of 900 lin. ft. of pipe; this friction in the case under consideration amounts to about 3.85 lbs. pressure per 100 ft. or 34.65 lbs., this is equal to an additional head of 80 ft., making the whole work of the pump 120 × 1541 lbs. = 5.61 net water horse power, but as only about 60 per cent of the engine horse power is converted into useful work, 9.35 indicated horse power would be required. A far better proposition would be to install the plant on the side of the bluff *B* opposite *A* at an elevation of about 20 feet above the water level indicated by point *F*. An intake ditch should be dug from the pond to the pump suction pipe along the low flat at the base of the bluff. From this point the length of the 3½ inch discharge pipe to lift the water to the 40 foot level will be quite short and the heavy loss in the proposed case will be avoided. Assuming that the length of the 3½ inch diameter pipe from pump *F* to point *G* at the 40 foot level is 100 feet then the loss due to this pipe line will be only 1/9 of 80 feet, say 9 feet, which added to the head of 40 feet makes 49 feet of total head required. There is also a considerable saving in the pipe purchased as the water from the point G can be taken care of by ditches or a flume. For good work a wooden flume should be built from G to E with outlets for the lateral ditches indicated by the dotted lines *GG, HH, II, JJ*, etc. These ditches should not be made too deep and should be built with a slight grade so as to carry the water near the farther side of the field. The number of these lateral ditches depends of course a great deal on local conditions.

The flow of 185 gallons per minute is about .4 cubic foot per second, exactly .412 c. f. s.; if it is kept up for 24 hours it will mean a pumpage of 266,400 gallons or 35,615 cubic feet; this would be enough to cover one acre 10 inches deep, or which is the same as to cover 10 acres 1 inch deep, and as the land is located in Kentucky, where there is a great deal of rain, the writer cannot see any reason why this plant should not be able to furnish all the irrigation needed for these 45 acres by alternately turning on the water for the upper 15 acres, say for 24 hours, then turn the water on the middle 15 acres and then on to the lower 15 acres as required. In this way different fields could be laid out, arranging it so that the crops requiring the most water be planted in fields adjacent to the flume *GE*, which would facilitate the irrigation work.

The problem under consideration shows how necessary it is, however, to study each individual problem in irrigation in order to determine the best and most economical layout.



WANTS A DEFINITION FOR HYDRAULIC RADIUS.

Editor Irrigation Age:

Permit me to offer you my compliments on the splendid paper which the Irrigation Age is getting to be, and I would not do without it if it cost five times as much. Your latest improvement, the addition of a Correspondence Department, in which readers may ask and answer questions, is a long step in the right direction and will make your paper more popular than ever.

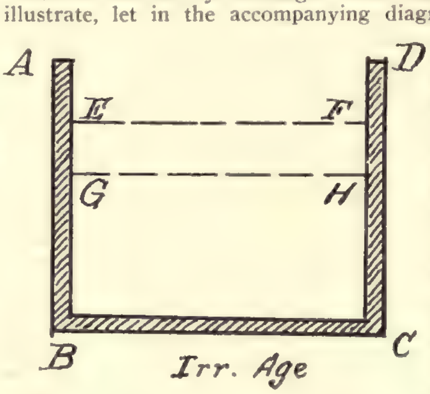
There is a question that I would like to be enlightened on, it is used in hydraulic works, but I never heard a clear definition for the expression "hydraulic radius." I would appreciate it very much if you would explain this in your paper, as there are undoubtedly others who will be benefited thereby.

Thanking you in advance for a reply in the columns of your paper, I remain

A Faithful Reader.

The inquiry in the above letter relates to one of the principal elements in hydraulics and will receive complete attention in the "Primer of Hydraulics" in the course of a few months. However, there is no reason why the subject should not be editorially explained at this time.

The hydraulic radius, also termed hydraulic depth of a water channel, is a fraction obtained by dividing the flow area of a channel by the length of the wetted perimeter. To illustrate, let in the accompanying diagram, *A B C D*, be a cross section of a rectangular flume, the flow line reaching the line *E F*; let the width, *B C*, for instance, be equal to 3 ft., and the depth, *E B*, equal to 2 ft.; then the flow area will be 3 × 2 = 6 square ft.; the wetter perimeter will be *EB* + *BC* + *CF* or 2 + 3 + 2 = 7 ft.; hence the hydraulic radius will be found by dividing 7 into 6, which is 6/7, or changing to a decimal fraction the hydraulic radius eqnals .857 feet. As the depth of the flow decreases the hydraulic radius decreases also, for instance: let *BG* equal 1.5 ft., then the flow area will be 1.5 × 3 = 4.5 square ft.; the wetter perimeter will be: 1.5 + 3 + 1.5 = 6 ft; hence the hydraulic radius equals 4.5 ÷ 6 = .75 ft.



The hydraulic radius is usually given the symbol *r* and is an important factor in determining the sizes, grades, etc., of irrigation channels.—Editor.

A SUBJECT OF GREAT IMPORTANCE.

To the Editor:

In the face of a state of things through which the people of the states west of the Missouri river have been most shamefully wronged, I have seen no protest, no public declaration of the wrong itself nor the methods of its inflictions. For this reason and because time presses toward a day of reparation, I ask leave to speak through you and describe what I will call the crime of nineteen-ten.

For a few years preceding that one, there had been a strong and healthful flow of men and money into Montana, Idaho, Washington, Oregon, California, Utah, Wyoming, Colorado, Arizona, New Mexico and Texas. Government had expended vast sums in projects to gather and distribute the waters of those arid or semi-arid regions, and private and corporate interests had gone even farther, both in territory reclaimed and in the cost of reclamation, fostered by state enactments, favored by all the people, and availed of by hundreds of thousands. Waste places had been brought into such productivity as no other country in the known history of the world had ever even approached. The climate of that greater and more important half of the United States favors healthful living and a prolongation of human life, out and way beyond any other on this hemisphere, and the development of its soil-power meant better returns, greater prosperity and more content than the people of the other—the eastern half—had ever dreamed of or can ever hope for. It was no wonder, therefore, that the movement I have spoken of set in and grew. The people were taking their heritage, and finding it good.

No work done by any set of men has ever equalled in importance that which was devoted to western irrigation. No other work has had so immediate an effect in benefitting so many, nor so incalculable a significance for future generations in an area so vast and of such tremendous possibilities. In the course of a very few years, say at the outside ten, the states of the west waked into full-blooded life and a rising power that in a very few years more would, if unchecked, have put them in the very first position among the possessions of civilized mankind. That position is inalienably theirs, and can not be withheld, no matter what drawbacks may intervene nor what harm may be wrought in the effort to defer it. But the west itself must take its own destiny into its own hands; and a new declaration of independence must be made, this time by the west as against the east. Another, though a bloodless, revolution must be fought out, and the right of the west to realize itself and its resources must be established.

Up to 1909 there was a steady increase in the western tide, and the actual wealth of the nation was growing by billions every year. In the beginning of 1910 it stopped short, and disaster overtook most of those who were leading or directing it. The cause of this sudden and criminal retardation of the country's best and most helpful interests lay in the little district east of Broadway and between Cedar street and Exchange place, in the city of New York. The financial district, as that neighborhood is called, or "Wall Street," as it is more generally known, lives through and is dominated by the New York Stock Exchange. The banks or New York are the ultimate depositaries of the banks of the country, and the flow of money to legitimate and necessary uses in the west had been more and more heavily diverting bank deposits from the uses of the stock exchange. Early in 1910 a few men, sitting in the center of that enormous web, took quick and vigorous action to reverse this order and bring the country's money once again into the street. It was a simple operation, but swiftly and mercilessly effective. The securities of irrigation projects were absolutely forbidden the use of banking money throughout the middle states and the east, either as issues or as collateral; loans to people who wanted to buy western lands were strictly prohibited; and no depositor was allowed to check his own funds out of any bank in the Union for the purpose of a land purchase without first having to withstand every possible effort of the bank's officers to dissuade him. The result spelled ruin to many an enterprising bond house, and the stoppage of nearly every irrigation project in the whole west, save those in the hands of the federal government. Irrigation bonds in good projects are probably the best of all securities, because they rest in primary property worth many times their face, and the interest rates are higher than those paid by any other security having anything like their safety. They were the blood and the life of the new development that began with the century, and their sale was easy.

The banks of all the great cities carry funds in the banks of New York. The banks of the smaller towns carry funds in the banks of the great cities. The ramification is complete. New York dominates the banks of other cities. The other cities dominate the banks of the country towns. The country banks carry the money of the people in their own towns, and on the outlying lands. A decree of the banking power of New York therefore reaches to the most remote places, and determines the use of the money of every man, anywhere, who has an account in any bank; and this is especially and strenuously true of all accounts carried in savings banks. Thus it was an easy thing for the banking power of New York, centered in two or three men, to stop at a stroke the progress of the west.

That is actually what was done. The banks had direct and peremptory word *by letter* from New York to throw out all land and irrigation securities, and to do it at once.

Following that letter, a New York bank official made a personal tour of the western states and confirmed it, visiting every principal bank, and seeing to it that the country correspondents of each of them got the instruction. The paralysis was almost instantaneous.

It is not a strange thing, but a monstrous evil one, that the bankers of the United States, whose bank capital will not average five cents on the dollar of the money they hold and control, should have been able to do this colossal injury to the whole nation, and particularly to the people of the west. We have no real banking system. We are a bank ridden people, carrying the burden of an unreasoning tyranny, and working for those who run the Wall street game. The average of ability and of business judgment in the banking interest is immeasurably below that which is necessary to success in any of the country's real lines of business or industry. Banking in the real sense we never have had. In its place there is an immense pawn brokerage, that gets its profits by loaning the funds of its depositors to the fevered purposes of the stock market in New York.

Little or no attempt was made to account for or explain this squelching of the west. A few magazines had elaborately wrought out a case in which the growth of the automobile industry was made to appear responsible for the "extravagance" of western farmers, and a consequent dimunition of the supply of money flowing eastward. That fooled no one. When the real blow fell, there was no explanation, no reason set forth. It just fell, and that was all there was to it. The metropolitan newspapers, commercial, all, and accordingly jealous of any criticism of the banks, took little note of it, except here and there to assault irrigation securities as things overdone and dangerously speculative. The damage was done, and there was neither defense nor recourse.

If relief is to come through any process other than the mere lapse of time, and the slow motion of events as left to themselves and the overcoming of their own inertia, it must come through an organized movement in the western states, which shall work out a new and real system of banking by the state and county governments. The initiative in that movement will have to be taken by the land associations. Those associations must combine in a general organization and the governors of the states concerned should all be made directors. Banking laws will have to be made over again, and the business taken out of private hands and brought under civil service by the states and the counties. We need no national banks, with dictation from Wall street or from men high up in the federal government, who by the action of a force called "enlightened self-interest" keep step to the Wall street tune. The people of each western state must assume charge of their own money, and be allowed to use it for their own purposes, to borrow or to lend as may best advance the work they have to do. Western money for the west, that is. Distinct and absolute control by the west of the funds of the west, for the prosperity of the west. Does anyone presume to say that such a condition can not be brought about? The men of the west know their country and their prosperity means thousands of times more to the nation and the world than all the exchanges and bourses of the world put together. Is it conceivable that they are not capable of managing their own affairs? They are admittedly better in brain, brawn and integrity than the men of the older and less virile parts of the coun-

try. The very air they breathe and the sunshine that fills the western days make them that, and will so maintain them. Why should they take meekly the ruthless mauling of New York—of non-producers whose business is confined solely to shaving other people's money?

I shall not undertake here to elaborate details in this suggestion, but I do move here and now that the thing be started. Until someone else better fitted for such work can be found, I will assume the center, and invite those most directly interested to communicate with me. Let us get a committee together for the purpose of creating such an organization as I have indicated, and go to it. The occasion is serious and calls for action, more than for words. Who will come forward and join me in the necessary preliminaries *now?* J. C. O. N.

How to Raise Oats on Irrigated Land.

Salmon, Idaho, April 2, 1911.

Editor IRRIGATION AGE:

There seems to be general interest in the subject of the irrigation of oats. This is perhaps the simplest of all crops to grow to a high degree of perfection by the use of artificial water. In the arid belt the conditions of soil preparation, sowing and the first stages of growth are identical year after year. There seems to be no element of risk in the oats crop by irrigation, when the rudiments of science are applied.

Scientific farming is the grandest study of the age. Scientific farming eliminates every element of risk in the production of maximum yields. There is no justification for the production of less than 100 bushels of oats to the acre by scientific methods. The only climate which never varies is the practically perpetual sunshine of the arid regions. Scientific farming is possible only where the sunshine is perpetual and the supply of moisture is under the absolute control of the scientific farmer.

To produce a perfect crop the seed must be properly planted in the correct degree of moisture in the right season. The question of fertility is determined with certainty only when the degree of moisture is regulated. It is not necessary to try to illustrate the degree of moisture required for the seed bed to the practical farmer. The degree of moisture necessary to promote the rankest possible growth of straw is readily determined by the experienced farmer either in the humid or the arid regions. If there is not an excess of fertility in the soil farming by irrigation is a simple process. The application of water in response to the demands as indicated by the changing color of the plants is a very simple matter. The impossibility of definite determination of the correct degree and quality of fertility complicates the principle of irrigation of the oats crop. The moisture regulates the feeding of the fertility of the soil to the plant even when there is an excess in the soil. Therefor the scientific irrigator can regulate the growth of straw by limiting the moisture, and be sure of the height that will not lodge and at the same time support the very largest heads. With the moisture under control it is just as much faulty farming to have lodged straw as to have a poor yield.

The trench system of water applications is the best for oats crop. The trenches are generally made by a marker which will make two trenches about twenty inches apart, two inches deep and three inches wide. This work is generally done after seeding and before the grain comes up. It greatly simplifies the irrigation by being certain of the correct degree of moisture in the soil before the seed is sown. This moisture will make a growth of about four inches and cover the surface with a dense green mass. The green oats will shade the surface so that the wet ground will not bake. Successive applications of irrigating water will be called for by the unmistakable changes of color of the growing crop. A growth too rank may be readily checked and a retarded growth may be stimulated by frequency and extent of the applications of irrigation water.

NEWTON HIBBS.

FROM A BEGINNER.

Mr. D. H. Anderson:

As I am a subscriber to your IRRIGATION AGE would like to ask a few questions. Have been railroading for twelve years and am now going to try farming. Have taken up a homestead, built house and stable. Have a spring on place with big ditch. Am going to clear off about ten acres of sagebrush and want to put it in alfalfa, barley, oats and some wheat. I thought of putting the oats and alfalfa together and barley and wheat separate. I want the wheat for chickens and barley for horses and hogs. Oats and alfalfa for hay. Don't expect to get much under cultivation the first year, as I want to get land and ditches to running right. Where I am the soil is black loam, deep soil and sloping land, sloping toward the northwest. What I would like to know is what is your advice in planting the grain and whether to irrigate in flooding or make light furrows with cultivator and put the alfalfa and oats on the highest ground and wheat and barley below it. Let me know when my subscription expires and I will renew same for IRRIGATION AGE.

C. H. A. GERDING, JR.

Carlin, Neb.

WANTS INFORMATION REGARDING MONTANA.

Mr. D. H. Anderson,

Chicago, Ill.

It gave me much pleasure to learn that you have opened an information bureau regarding the reclamation projects and I take the opportunity to avail myself, as a reader, of such information you may have regarding the projects contemplated in or about Helena, Montana, or controlled from that office. I would like to know how much is to be expended the coming year, and how soon the work, if any, is to begin.

Thanking you in advance for this kindness, I remain,

Very truly yours,

JAMES H. O'CONNOR.

We are glad to hear from Mr. O'Connor that he approves of our correspondence department. Regarding his questions as to projects near Helena, Mont., we refer to our Irrigation and Reclamation Notes in this and former issues, where the state of Montana has been given an especial heading.—Editor.

PERSONAL.

Mr. Richard A. Ballinger announces that he will re-enter the practice of the law, with offices in the Alaska Building, Suite 1006-1009, Seattle, Wash., April 20th, 1911. Mr. Bruce C. Shorts will be associated with him.

David R. Francis, of St. Louis; D. B. Chapin, of Edwinburg, Texas, and other large land owners of that state, are working out a plan to construct a large irrigation system and install hydro-electric plants on the Devils and Pecos Rivers, in the western part of Texas. The estimated cost is over $5,000,000, which will provide irrigation facilities for nearly 400,000 acres.

The Hawaiian Island of Lanai, which has been practically barren for several years, will be reclaimed by a water conservation system and devoted to sugar beet culture.

Residents along Bad River in Stanley County, South Dakota, are preparing to use the water of that stream for irrigation this year by the use of pumps. While they may not need the water, they are preparing for another season when it might be needed and are installing pump outfits at several places to raise the water and place it on their gardens in case they should need it this year.

Hale County, a country in the lower Panhandle of Texas, this year enters the list of irrigation sections. Heretofore the people have been satisfied with windmill irrigation. An experiment was tried of carrying a well down to a depth of 130 feet, 50 feet of which was in what is now known as the gumbo strata. A 7-inch centrifugal pump run for several days at its highest speed could not lower the water in the well. The estimated discharge was 1,700 gallons per minute.

Reclamation Notes

CALIFORNIA.

Chief Engineer Hoar, of the Northern California Power Company, has installed eight electric motors for irrigation pumping plants. Among them is a 30-H. P. pumping plant for W. M. Shaw, the millionaire lumberman of Maine, who is experimenting with the productive capacity.

A contract has been entered into for the construction of big levee system that will reclaim 10,000 acres of land in Yolo County, to be called West Sacramento. The contract is for $100,000.

Irrigation from pumping plants is being resorted to with great success in the vicinity of Paradise, Butte County, the water being only about fifteen feet under the ground.

The Board of Directors of the Oakdale Irrigation district met recently and decided to advertise for sale $1,000,000 worth of bonds. They also decided to advertise for bids for the construction of 100 miles of concrete canals.

Notwithstanding the refusal of the Board of Supervisors to contribute to the project for fear of establishing an expensive precedent, the directors of the Hallwood Irrigation District have proceeded with the work of digging the main ditches and laterals. Twelve men were engaged upon the main ditches and four on the laterals. It is hoped to get water on the land included in the district this summer. The water will be taken from the Yuba River near the Diggs farm.

It is reported that the irrigation system for the Indians near Banning will probably be completed this summer. After many unavoidable delays, C. R. Olberg, head of the engineers for the Indian Department, has taken charge and is now giving his personal attention to the project. The work was started two years ago and a tunnel was put in, with a considerable mileage of cement ditch. It is expected that the land will be allotted in small tracts when the waterworks are done.

Many water users of Yolo County met in the chambers of the Supervisors recently at a hearing for the fixing of water rates by the board. The interested parties are the Yolo Consolidated Water Company and the water users on the ditches of the company. The object of the hearing is to fix the value of the property of the irrigation company, and if the present rates do not net the stockholders 6 per cent on the valuation, it is proposed to raise the rates. Judge M. K. Harris of Fresno and E. W. Armfield represent the company, A. C. Huston the water users on the Moore Ditch and Thomas & Thomas and Grant Hudson some private ditch companies.

Official announcement has been made by the Sacramento Valley Irrigation Company that an agreement and all papers had been signed by the company and the land owners of Glenn and Colusa Counties, who have been engaged in litigation with the company, whereby the litigation will be abandoned, all cases in court dismissed and, after certain court formalities have been attended to, the bonds, which for years have clouded the title to the vast tract of 151,000 acres of land owned by the company, will be destroyed.

Rio Vista will be benefited by the reclamation of the Egbert district at an early date so that the entire acreage can be cultivated this season. The district is one of the most fertile in the state and the large crops it will produce will give employment to many men. The work commenced by the government at the mouth of the river should render the Egbert district safe from overflow in the future and make it one of the great producing sections of California.

To irrigate 23,000 acres of land in Butte Valley is one of the objects of the Central California Land Agency, which has purchased all the interests of the Butte Valley Land Company. The transfer includes 23,000 acres of land, the townsite of Macdoel and the hotel. The company is buying land from the Dunkards and any one who wishes to sell. The land will be colonized in twenty, forty and eighty-acre tracts and the purchasers will be provided with water and a market for their produce.

The United States Department of Agriculture has just issued a progress report of co-operative irrigation investigations in California covering the ten-year period 1900-1910, which is available for free distribution on application to the United States Irigation Investigations, Berkeley, Cal., or the Secretary of Agriculture at Washington, D. C.

Several carloads of mules recently arrived at Willows to be used for work in building laterals for the Sacramento Valley Irrigation Company. Hundreds of miles of these ditches will be constructed during the coming summer and hundreds of men and teams will be used.

Work on the great Orland reclamation project in Glenn County is complete, the Kugh reservoir backed up by the East Park dam is full and overflowing and the entire system will be opened and water distributed over 14,000 acres of land. The great dam is one of the most substantial and imposing concrete structures in Northern California.

There are thirteen breaks in the levee system of the back-water slide of Reclamation District No. 108 of Colusa County, and water is flowing through all of them. The three dredges and the three hundred men employed have been unable to stop the breaks.

The Comptroller of Currency recently decided that the Reclamation Bureau could not spend this year $50,000 on the Modoc Point and Klamath Reclamation projects. The reason was given that Congress has limited the cost to $155,000 instead of $185,000 as was estimated. This means a year's delay unless a remedy is found.

The great McIntosh and Kraft tracts of land in Glenn County and Tehama will be thrown into a municipal corporation under the revision of the Wright law at once and water pumped from the Sacramento River to irrigate them. The two tracts contain about 13,000 acres.

The United States Department of Agriculture reports that construction work is now under way that will, when completed, result in the irrigation of 750,000 acres of land in California. Of this area about two-thirds lies north of Tehachapi and the remainder in southern California.

COLORADO.

Much activity is noticeable around Wilson and throughout the section of land under the Pueblo-Rocky Ford project which will be brought under irrigation this Spring. The company expects to turn water into the ditches very shortly and several thousand acres of land will be irrigated during the present year.

The plan of the men back of the Laramie-Poudre irrigation project and the Greeley-Poudre irrigation district, to raise capital to complete the gigantic scheme which will place 125,000 acres of Weld county land under water, was made public recently. The plan also called for the annulment of a contract with the Chicago bonding house which guaranteed the sale of the construction bonds upon the payment of $250,000 by the bonding house.

The largest sale of irrigated land in the vicinity of Denver made so far this year has just been closed for the transfer of the 900-acre tract, known as Pomona, lying three miles north of Arvada, to George E. DeWolf, formerly of Mongango, N. D., at an average price of $150 an acre, or about $135,000 for the tract.

Dr. W. P. Harlow of the state university, recently elected president of the Association of American Colleges, is pushing an irrigation project by which nearly 2,000,000,000 cubic feet of water will be available for use in Boulder and vicinity. The old Owen Lake, north of Boulder, which draws its water from South Boulder Creek by ditch, is to be increased in

capacity by raising the dam at its outlet 9 feet and increasing the length of the retaining wall 1,559 feet.

The Orchard Mesa County presents a busy scene this season as scores of teams are engaged in breaking the ground preparatory to the planting of crops. The new irrigation system is being placed in the finest possible condition and more water will be pumped this season than will be required by the farmers.

Dr. B. L. Jefferson, register of the State Land Board, has ordered the segregation of 136,000 acres of state land in La Plata County at the request of the Interstate Irrigation Company. The company intends to begin the construction of a $1,000,000 irrigation project that will reclaim this large tract of land. It is planned to water this tract from the Animas River.

NEW MEXICO.

While W. Goff Black of the Aztec Irrigation Company has nothing of a final nature to give out regarding the ditch project of his company, a few facts on this big enterprise will be of interest to our readers. The ditch will take its heading above Cedar Hill and will run east of Aztec, and then cover some fine land on the San Juan river slope. In addition to the land covered by gravity ditch, this company, which owns and is enlarging the Aztec Electric Light Plant, will pump on to land that lies just above their ditch line close to Aztec.

A recent edition of the Estancia Herald says: "There are several thousand acres being broken between Estancia and Stanley." Other exchanges tell the same story from every part of New Mexico. Receiver Sims of the Federal land office at Las Cruces declares that more land is being broken in the Mesilla Valley this year than ever before and that with each year more virgin land is brought under irrigation and cultivation.

MONTANA.

Action has been filed against the Bitter Root Valley Irrigation Company by Louis H. Fales, asking a judgment of $4,500 and costs to reimburse him for loss of last season's potato crop, alleged to have been destroyed by reason of the defendant's failure to supply water from its ditch to the land owned by the plaintiff. A contract is alleged to have been violated in the matter.

IDAHO.

The farmers of Carey and vicinity are organizing a district under the new law to irrigate land along the Little Wood River that cannot be covered otherwise.

OREGON.

The Ontario Townsite Company, of Ontario, has ordered machinery, motors and pumps, costing over $8,000 to irrigate 1,000 acres of land adjoining the town. The work will be completed this spring.

Operations on the Klamath irrigation projects under the direction of the reclamation service will soon be under way and a busy summer's work has been planned. Already a force of men and a number of teams are working on the canals and laterals, making whatever repairs are necessary and placing them in shape for carrying water during the irrigation period.

The reorganization committee of the Deschutes Irrigation and Power Company, now the Central Oregon Irrigation Company, is preparing the details of the proposition to be submitted to the stockholders of the old company. The plan in detail will be sent out in circular form to the stockholders of the old company and the responses received will determine what further steps will be taken in the matter of the protection of the holders of Deschutes stock.

UTAH.

The work on the Strawberry tunnel reclamation project is more than half done, which is good news for the Spanish Fork farmers who will, on its completion, reclaim some seventy thousand acres of arid land. This tunnel is probably the longest ever undertaken by the reclamation service, being but little short of four miles in length.

A number of the officers of the Sego Irrigation Company visited Provo bench recently to see the water turned into the system and delivered on the land owned by the stockholders and others. The company owns water in the lakes at the head of Provo River in connection with the Provo Reservoir Company, and also high water rights in Provo River.

At a mass meeting of citizens, county and city officials and members of various irrigation companies of Weber County, held recently, the project of constructing for Ogden and vicinity a monster reservoir in South Fork Canyon was carried through with great enthusiasm, sufficient stock in the proposition being subscribed to insure the success of the enterprise.

An irrigation project is now well under way with President Jos. R. Murdock at its head. It is a pumping and canal system that is designed to irrigate about 40,000 acres of ground lying west and north of Utah Lake, from which body the water will be taken. It is the purpose of the company to have its system in working order for use in 1912.

VALLEY LAND RESTORED.

The fruit of an actual inspection of Owens valley "forest" lands by forestry bureau heads is here at last, in a proclamation eliminating 275,424 acres of land from the Inyo reserve. The proclamation was signed by President Taft February 23d, a fact of which we would without doubt have been immediately advised but for the illness which compelled Congressman Smith, our faithful champion, to leave Washington.

There have been additions to the forest made to the amount of 80,502 acres, a small part of which is in Nevada.

At this writing no copy of the proclamation has been received here, and the new lines are not positively known. At the conference here between Associate Forester Potter and our citizens, the latter asked that the line be moved back to its first location, which practically followed the base of the Sierras. Mr. Potter indicated that this would be acceptable to the Forestry Bureau. It is presumed that the line has been practically re-established as it was before Roosevelt and Pinchot, to help Newell and Lippincott along in their Los Angeles allegiance, overrode the spirit and letter of the forestry laws, in blanketing fertile Owens valley with the obnoxious reserve. Obnoxious it is only when placed or used contrary to all justice; in its proper place, covering the forests or mountains irreclaimable by settlers and administered by men of practical sense rather than by theorists, we believe the forest service was created none too soon. It simply fell into fanatical hands. Whatever else may be said of Secretary Ballinger, he did real conservation a service when he kicked out Pinchot. In its local bearing, only that change made it possible for this valley to secure the tardy justice which has been done to it.

The United States has nearly 13,000,000 acres under irrigation and 8,000,000 acres in course of irrigation. This shows the tremendous development toward land recovery, because of the high food prices.

Several stupendous irrigation projects are contemplated for the section west of San Antonio, Texas. They came to light recently in the hearing before the Railroad Commission when the question of the devolpment of that section was being discussed in connection with the extension of common points territory to Del Rio and Eagle Pass.

E. H. Perry's irrigation well, five miles west of Dallas, Texas, was tested recently and made good in every sense of the word, and is throwing about a thousand gallons per minute, the flow having increased from 370 gallons.

Indications are that there will be greater activity in irrigation enterprises in the western part of Kansas this year than ever before. Ritchfield, Kansas, already has a big artesian well and two more are being drilled not far from there.

An effort is being made to turn 98,000 acres in the vicinity of Tonopah, Nevada, into fertile agricultural property by men connected with the Tonopah and Goldfield railroad.

MAKING IT EASY FOR ALASKAN FARMERS.

Governor Clark, of Alaska, who is a plain newspaper man when he isn't governing, and a very shrewd one, said that farming would some day be Alaska's chief industry. That was a large order and it made a lot of people who have never been to Alaska smile scornfully. They forgot that Governor Clark was a newspaper man and that he knows Alaska a great deal better than most New Yorkers know their state, for instance, or than most Coloradoans know theirs. They also forgot if the same thing had been said of Colorado, or California or Idaho or Oregon a few years ago, they would have smiled just the same and would have been quite as wrong.

Uncle Sam has been notoriously remiss in care of the baby empire he is bringing up on the fresh air plan up north there, but there is one thing he has done. He has proved beyond the shadow of a doubt that Alaska is no more unsuited to farming that Norway and Sweden, which is another way of saying that Governor Clark's pronunciamento has been officially confirmed by the Department of Agriculture, the Department of the Interior, Congress and various individual officials.

Moreover, "something is being done about it." In this respect, at least, Uncle Sam is taking care of his baby. He is doing all that can reasonably be expected of so self-absorbed a parent to make a farmer of the youth and the child is responding well.

For several years Uncle Sam has maintained five experiment stations in Northland. That was not a great many, but it was enough to make many important and hopeful discoveries and to start real farming. Then he doubled his inducements to settlers, by making the Alaskan homestead 320 acres instead of 160 as it is in "the States." This still left it necessary, however, for the Alaskan settler to pay the cost of a survey before he could secure title and a survey in Alaska was often an expensive thing. Now this obstacle is being rapidly overcome. Congress made an appropriation in 1910 to cover the cost of a government survey of the chief farming areas that would first be occupied. This work was put in charge of the Geological Survey and the first part was done last summer. A basis has now been established that makes it needless for farmers taking up land in Alaska to bear the cost of the survey. They have, in fact, virtually no expense, except getting to the place they want to occupy

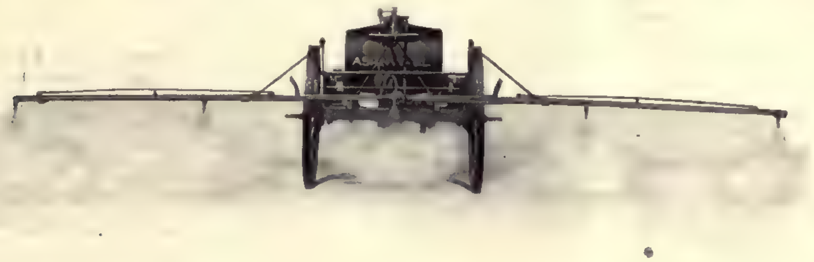
Numerous homesteads have already been taken up in the territory, notably in the Tanana valley of the interior, in the new Kotsina-Chitina country recently penetrated by the Copper River and Northwestern Railway, around Seward and in the Susitna basin. There are four well-developed farms near Seward, several around Knik on Cook Inlet and any number in various parts of the interior. They are making money, too, whereever they are near local market not too available to Seattle. Around Fairbanks, for instance, the only competition that homegrown oats and potatoes must meet is produce shipped by rail to Seattle, then carried on a 2,000-mile sea voyage and transferred to river steamers that must haul it upstream another thousand miles. The cost of all this haul makes a protective tariff in favor of the local farmer that even the Aldrich bill cannot equal. Compared with gold mining, even as it is in Alaska, these northern farmers have been doing almost as well in a surer, easier way.

Moreover, there is room for a great many more. A mining camp will absorb many hundreds of tons of supplies in a year, a large part of which can be grown locally. And there are many mining camps. One article for which there is always a demand is oats. The heavy work of the trails makes hearty feeding of pack horses necessary and oats are everywhere at a premium. Yet they can be easily and successfully matured in a score of valleys of the territory.

The suitability of Alaska for stock raising has been amply proven and this, it is predicted, will play a large part in its future fame. Yet this industry is only just begun. We may not have enterprise enough to go and pioneer ourselves, but we may well watch with interest the progress of this most important development.

THE "ASPINWALL" DOUBLE CYLINDER SPRAYER.

In no country do the growers suffer such losses from the various insects and different forms of blight as in America. This without doubt is due to the fact that our farmers operate on so much larger scale that they didn't realize, when these pests first became apparent, the damages that would result; hence, did not begin a systematic fight against them until the evil had obtained a strong footing.



Aspinwall Double Cylinder Sprayer with 20-ft. Boom Arranged for Spraying Five Rows of Tomatoes.

But the time has now come when every farmer is alive to the situation.

The farmer has free access to the vast knowledge gained by the Experiment Stations connected with our agricultural colleges, in their close and thorough study of this great subject.

There must, however, be a machine for handling all these preparations, and they must be adaptable to the various crops. A few years ago an all-purpose sprayer seemed an impossibility, but today if care is taken in selecting your first machine you can add attachments for nearly every phase of the work.

For three seasons the Aspinwall Manufacturing Company, Jackson, Mich., have put out a Double Cylinder High Pressure Sprayer. Last season they furnished Orchard and Broadcast Attachments which could be used in connection with this machine, and the present season are putting out five additional atatchments. By placing the hose bars vertically instead of horizontally a very effective Vineyard Sprayer is produced, which can be used advantageously wherever the width of rows will permit of driving between. They also have Low-Down Attachment for spraying potatoes and such crops from underneath. By the addition of a twenty-foot boom at the rear of the Sprayer, adjustments may be made whereby three rows of cucumbers can be sprayed, four rows of tomatoes, five feet apart, or five rows four feet apart, also five rows of potatoes.

Aspinwall Double Cylinder Sprayer with Hose Bars Arranged Vertically for Spraying Vineyards.

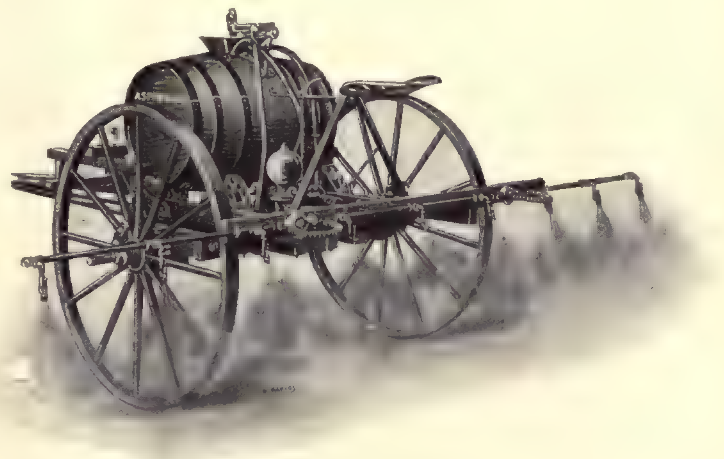
The three cuts illustrate the various attachments. Cut No. 1 shows the "Aspinwall' Double Cylinder High Pressure Sprayer with the Broadcast Attachment. Cut No. 2 shows the same arranged vertically for spraying vineyards, and cut No. 3 shows the 20-foot boom arangement for spraying five rows of tomatoes.

This company has just issued a special sprayer circular, illustrating and describing these various attachments, which can be had by addressing them at their home office, Jackson, Mich.

LEGISLATION IN WASHINGTON.

After hearing protests by Lauchlin MacLean, president of the Spokane Canal Company, A. J. Shaw, representing the Spokane Land and Water Company, and O. L. Olson, representing the Arcadia Irrigation Company, the irrigation code drafted by Governor Hay's commission was withdrawn from the committee of the legislature of Washington. Mr. Olson said that the irrigationists were not consulted by members of the commission, adding that none of the men appointed by Governor Hay is cognizant of the real conditions.

The Secretary of the Interior has awarded contract to Mr. Nelson Rich of Prosser, for the construction of about 73 miles of laterals in connection with the Tieton unit of the Yakima irrigation project.



Aspinwall Double Cylinder High Pressure Sprayer with Broadcast Attachment.

Nelson Rich of Prosser has the contract for the construction of about 40 miles of laterals in connection with the Tieton unit of the Yakima irrigation project. The work involves the excavation of about 230,000 cubic vards of material. The contract price is $116.070.

Methow Valley Irrigation Company, incorporated under the laws of the state of Washington with a stated capitalization of $1,500,000 and John W. Ellingsworth of Pateros, Wash., president, and Charles T. Borg, secretary, will begin work in April on a project to supply water from the Methow river to several thousand acres of land in Okanogan and Chelan counties, in north central Washington. The company holds options, expiring in April, on seven large tracts of land on Pateros, Tupper, Brewster, Antoine and Howard flats.

Right of way has been granted for the construction of a canal through the Yakima Indian reservation for the Klickitat Irrigation and Power Company's project in the Horse Heaven country in south central Washington, where it is planned to water 300,000 acres of land at a cost of not more than $60 an acre to the owners. L. M. Rice is chief engineer and manager of the project. Water will be taken from the Klickitat river, where a minimum discharge of 1,000 feet a second is available.

TWO YEARS OF CONSERVATION.

Over seventy million acres of coal land in the West is still owned by Uncle Sam. The coal content of this land is enormous; it can be figured only in hundreds of billions of tons. Some tracts are of immense value, containing beds of coal of the highest grade, 30, 40, 50, and even 80 feet or more in thickness. The old way was to sell the coal land, regardless of value, at the absurd figure of $10 an acre if it was more than 15 miles from a railroad or at $20 if within that limit. The present way is to measure the coal in an acre and sell the land at a price determined by its content of coal. As a result coal land has been priced as high as $400 an acre and one tract at even $600 an acre. Since March 4, 1909, the Geological Survey has classified, by 40-acre tracts, 8,527,166 acres of the government coal lands, at a total valuation of $560,815,081. Including the work done under the last administration a total of 13,480,538 acres has now been classified as coal land, at a valuation of $637,619,418. At the $10 to $20 minimum rate these lands would have a valuation of $218,289,942, so that the work done has resulted in a gain to the government of nearly $420,000,000. It may be noted that the proceeds of coal-land sales are all deposited to the credit of the "reclamation fund"—the fund that pays for the construction of the government's vast water-storage projects.

The work involved in the classification and valuation of the nation's coal fields is immense and the scheme under which it has been worked out is remarkably accurate and scientific. The best evidence of its accuracy is the ready acceptance of the estimates and valuations by purchasers of coal lands and the fact that the Geological Survey is constantly receiving applications and petitions for the classification of coal lands.

As a result of geologic field examinations this administration has also withdrawn 62,140,548 acres of probable coal land and has restored to agricultural entry 18,777,756 acres of noncoal land, which had been withdrawn from entry pending the Geological Survey's determination of its character. A single Montana withdrawal, made last July, included 20,208,865 acres. The amount of coal contained in this area is almost incredibly great. A single 40-acre tract, for example, contains over two and a half million tons of coal. The present outstanding withdrawals awaiting geologic classification aggregates 80,007,688 acres.

Another public fuel resource in the conservation of which the administration is taking an active interest is oil. Many of the public-land states are underlain by deposits of petroleum, with which natural gas is frequently associated. Two years ago the Geological Survey reported to the National Conservation Commission that the oil contained in the California deposits alone amounted to eight and a half billion barrels, and this estimate is now declared to be moderate. Careful geologic examination has been made of the western oil fields, and 3,796,572 acres of public oil lands have been withdrawn from entry in California, Oregon, Wyoming, Utah, New Mexico, Colorado, and Louisiana. These withdrawals are made in aid of proposed legislation, for the present gold-placer law under which oil or gas land must be acquired is absurdly inadequate and provides no means by which the government can retain an oil supply for the Navy, every new ship of which is now equipped with oil-burning furnaces.

Withdrawals of water-power sites on public lands by the Geological Survey in aid of proposed legislation have included thousands of sites. The withdrawals made during the last two years cover 161 streams in 12 states and aggregate 1,403,054 acres.

Even the classification of agricultural land in the West has devolved upon the Geological Survey, which during the last two years has designated 186,005,858 acres as nonirrigable and thus subject to entry under the enlarged-homestead act.

The Geological Survey has contributed most notably to the farming interests in connection with the discovery and classification of phosphate lands. Phosphate is as necessary a plant food as potash. The world's supply of phosphate is small, but fortunately the largest known deposits have been recently discovered in the public-land states of this country. As the result of careful geologic examination 2,548,145 acres of phosphate land are now withdrawn from entry awaiting legislation to safeguard them from monopoly, and another area recently discovered to be underlain with this mineral resource will soon be withdrawn. These lands include several areas discovered by Survey geologists. The lands withdrawn are in Montana, Utah, Idaho, Wyoming, and Florida.

The areas of public mineral lands of all kinds now withdrawn are given below, in acres:

Coal	80,007,688
Oil and gas	3,796,572
Water power	1,403,054
Phosphate	2,548,145

70-Acre Cherry Orchard on the Fountain Valley Land and Irrigation Company's Project.

Fountain Valley, Colorado

The country of sunshine, fine soil, good crops and delightful scenery

Fountain Valley, Colorado, is recognized throughout the United States as one of the most attractive sections of the West.

This tract is located between Colorado Springs and the town of Fountain. The section is world famed as a health resort—many of the larger fraternal organizations of the United States have established homes for their ailing members at or near Colorado Springs.

The Fountain Valley tract is, moreover, particularly favored and its superiority pronounced by the fact of its fine markets. Colorado Springs, Manitou, Cripple Creek, Victor, Colorado City (points directly connected with this tract), and other mining markets, to which Colorado Springs is the gateway, such as Leadville, serve, altogether, a population of over 200,000 people. This is in addition to the annual gathering of tourists at or near Colorado Springs, estimated at something like 200,000 people. Aside from the Fountain Valley, all of these places must secure their supplies from distant points, such as Greeley, through Denver on the north, or from the lower Arkansas Valley, through Pueblo on the south, thereby giving Fountain Valley a great advantage in the matter of freight rates. This valley competes successfully in the markets of Denver and Pueblo.

Alfalfa in the Fountain Valley yields larger returns in money than any other known place in the world, due to the superior markets.

Land may be purchased in this delightful section at reasonable prices and on favorable terms.

For finely illustrated folders fully describing this section, address

The Fountain Valley Land and Irrigation Company

Colorado Springs, Colorado

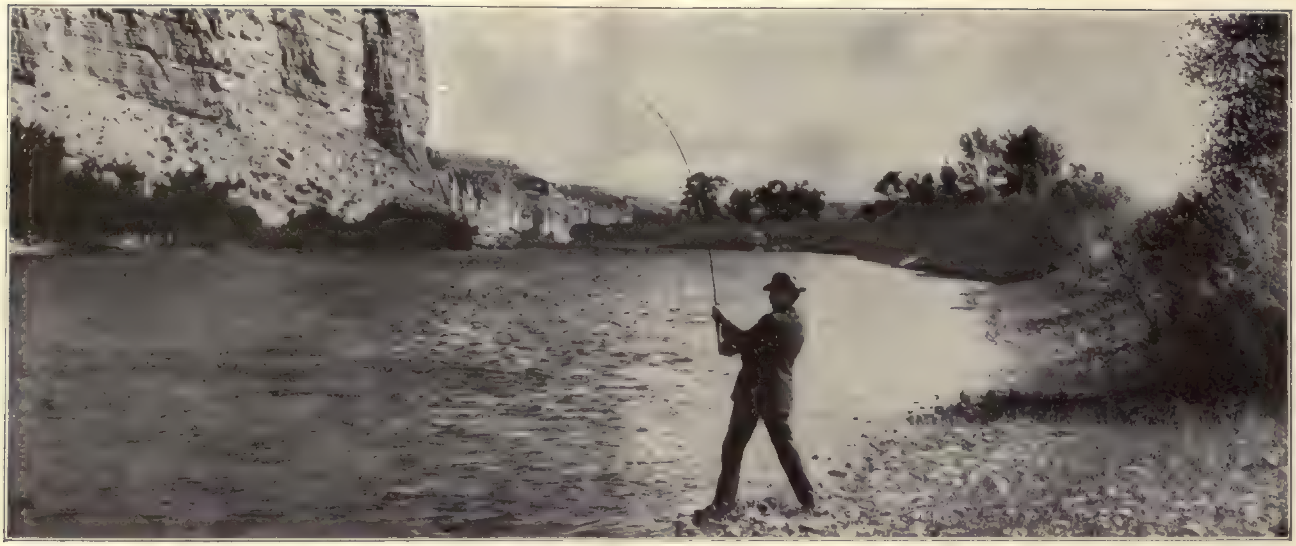
The House of Representatives passed a bill on February 7th, which had heretofore passed the Senate, permitting the Secretary of the Interior, in his discretion, to graduate payments required of settlers now on government irrigation projects, exacting of them small annual payments during their first year of residence and increasing them until at the end of ten years they will have paid back to the government the full charge assessed against the land for water, maintenance and operation.

Dispatches from Cheyenne inform us that George F. Roberts, a former Chicago banker, and W. L. Roher, of Chicago and Wyoming (who, by the way, is one of the active spirits in irrigation affairs in Wyoming), representing a British syndicate, secured from the State an option until July 30th on the water rights necessary for reclamation of the ceded portion of the Wind River reservation.

If the Roher-Roberts syndicate decides to take over the water rights, it will agree to irrigate 135,000 acres and to deposit $50,000 in cash to guarantee that it will keep its agreement. Under this agreement, settlers now on the ceded lands are to receive water for $30 an acre and others who may take land under the canals will be held for not more than $40 an acre.

Owing to the well-known character of the individuals connected with this new move, the AGE predicts a successful outcome.

An attempt will soon be made to have a law passed in Nevada which will empower the farmers of Mason and Smith Valleys to build a great irrigation and reclamation project, which it is estimated will bring under cultivation thousands of acres of land. The project is headed by Frank Fogel and George Reading, of Wellington, Nevada. These gentlemen have conferred with State Engineer Boyle recently at Carson, with a view to bringing this about.



Fishing Scene on the Platte River, near Saratoga, Wyoming.

A NEW DAM IN WASHINGTON.

The Secretary of the Interior is asking for proposals for the building of Kachess Dam and accessory structures near Saston, Washington. The work involves the excavation of approximately 345,000 cubic yards of material, the placing of about 240,000 cubic yards of embankment 15,000 cubic yards of riprap and paving, 8,000 cubic yards of concrete, 300,000 pounds of reinforcing steel, etc.

The water stored by this dam will be used in Yakima irrigation project.

IRRIGATION CENSUS.

The United States Government is making an irrigation census. The work of the investigators will be to visit every irrigation project of whatever kind, whether pumping from underground flow, utilizing the snows of the mountains, or storing the floods of the spring time, securing information about the time and cost of its installation, expense of maintenance, amount of water distributed, lands irrigated and products grown thereon.

BOLL WEEVIL PEST.

Alabama cotton raisers are face to face with the boll weevil pest. Mississippi already is suffering some damage. The insects travel faster along the southern end of the cotton belt than further north. The movement northward is more gradual, but not less certain. Irrigation or some similar plan to force the crop in rapid growth and early maturity may yet prove the best method of getting ahead of the bugs.

Practical and Scientific Farmer—Trained Farmer and Manager desires to become associated with a land owner as manager. Born and trained on a large Kansas stock and fruit ranch. Agricultural college course at Kansas State Agricultural College and Mechanical Engineering course at Cornell University. Trained in fruit growing and general farming on an extensive scale. Expert with farm tractors and all classes of labor saving machinery. Recently on the Pacific Coast in charge of irrigation development. Fair salary desired, but desires to draw only living expenses, leaving the balance for an interest in the business. Prefer South or West. Can "make good" in a place of large responsibilities and opportunities. Address, Olander, care Irrigation Age, 30 No. Dearborn Street, Chicago.

A New Style Steam Shovel Outfit

An Avery Undermounted Traction Engine With Special Steam Shovel Attachment

This Outfit has three very great advantages:

FIRST—In buying this Outfit you not only get a splendid Steam Shovel Outfit, but a complete Traction Engine as well, which you can use for General Hauling and all kinds of Traction and Belt Work.

SECOND—It requires no track to run on.

THIRD—Moves from one job to another can be made quickly and without the heavy expense of tearing the Outfit to pieces.

A number of these outfits have already been sold, and are in successful use digging drainage and irrigation ditches, stripping coal, loading gravel, digging sewers and other work.

Ask for catalog and special circulars fully describing this machine and showing it in operation.

AVERY COMPANY

965 Iowa Street | Manufacturers | PEORIA, ILL.

A Few Dollars Invested on Easy Terms in a

Twin Falls, Idaho, Orchard

WILL INSURE

An Income For Life

sufficient to keep a family in comfort. It will pay for a home that is not an expense, but

A Source of Revenue

Or for an investment which will pay from 100% to 500% every year as long as you live, and longer, after it comes into bearing.

By writing us you can obtain full information and a beautiful illustrated booklet

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Irrigators', Engineers., Prospectors' and Miners'

HIGH CUT BOOTS

Expressly adapted for irrigation work. Made of the highest quality and stock. Strong, Comfortable and Dependable. Many styles. Protect the feet and keep them dry. Can be secured through shoe dealers. If not obtainable, write to us

FOR A DRESS SHOE WEAR "HONORBUILT"

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MILWAUKEE Mayer CUSTOM MADE

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DRILLED WELLS FOR IRRIGATION

Make Every Well a Flowing Well

Flowing wells are not found in every locality, but they can be made to flow to their full capacity.

Every farm and every ranch should and can have their own water supply; a good well adds thousands of dollars to the value of a property.

The first item of expense is the only expense; a good well is inexhaustible and lasts for all time.

Big Profits in the Well Business

We want to send you our FREE book, "How to Make Money in the Well Business." It contains twenty pages from Sanderson's book, "Well Drilling, Methods and Cost," which is the only book published on the subject. It also describes our Advertising Plan which we are furnishing to our customers FREE.

Just drop us a postal today and we will show you how to handle a business in which there are REAL PROFITS.

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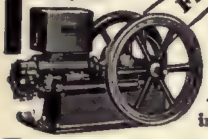
WITTE ENGINES

Gas—Gasoline—Distillate

Cheapest and best power known. Average cost one cent per horse power per hour. A superior standard of construction saves time, fuel and repairs. We refer you to thousands of satisfied customers. High grade engines our specialty for 25 years.

Five Year Guarantee



This engine is built for those who want the best. We furnish any size or style; hopper jacket or water tank type. We ship promptly. Everything is complete. Our prices are right. Inducements to introduce in new localities. Write for catalog, stating size wanted.

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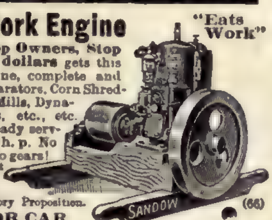
Let SANDOW Run It!

Wonderful Work Engine "Eats Work"

Farmers and Shop Owners, Stop Sweating! A few dollars gets this grand little work engine, complete and ready to run Cream Separators, Corn Shredders, Grist Mills, Feed Mills, Dynamos, Printing Presses, etc., etc. Gives a lifetime of steady service! All Sizes: 2 to 20 h. p. No cranking! No cams! No gears! Only 3 moving parts Finest construction. Thousands in use. Guaranteed 5 years. Write for Special Introductory Proposition.



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DETROIT MOTOR CAR SUPPLY CO., 178 Canton Ave., Detroit, Mich.

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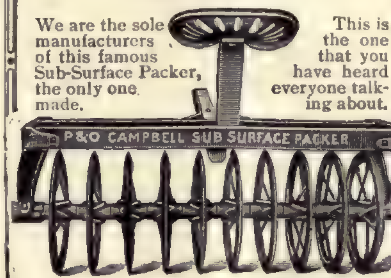
CAMPBELL SUB-SURFACE PACKERS

We are the sole manufacturers of this famous Sub-Surface Packer, the only one made.

This is the one that you have heard everyone talking about.



Send for our Special Pamphlet on Sub-Surface Packing, the best known system for "dry farming," a method of absolutely insuring bumper crops with a minimum rainfall—the salvation of semi-arid regions.

Made in **Three Sizes**, with 10, 16 and 24 wheels, is heavy and strong, and the frame is made to carry all the extra weight required. Write for Catalog No. V

Parlin & Orendorff Co.,
CANTON, ILL.

Use KEROSENE Engine FREE!

Amazing "DETROIT" Kerosene Engine shipped on 15 days' FREE Trial, proves **kerosene** cheapest, safest, most powerful fuel. **If satisfied,** pay lowest price ever given on reliable farm engine; **if not,** pay nothing.

Gasoline Going Up!

Automobile owners are burning up so much gasoline that the world's supply is running short. Gasoline is 9c to 15c higher than coal oil. Still going up. **Two pints of coal oil do work of three-pints gasoline.** No waste, no evaporation, no explosion from coal oil.

Amazing "DETROIT"

The "DETROIT" is the only engine that handles coal oil successfully; uses alcohol, gasoline and benzine, too. Starts without cranking. Basic patent—only three moving parts—no cams—no sprockets—no gears—no valves—the utmost in simplicity, power and strength. Mounted on skids. All sizes, 2 to 20 h.p., in stock ready to ship. Complete engine tested just before crating. Comes all ready to run. Pumps, saws, threshes, churns, separates milk, grinds feed, shells corn, runs home electric-lighting plant. **Prices (stripped), $29.50 up.**

Sent any place on 15 days' Free Trial. Don't buy an engine till you investigate amazing, money-saving, power-saving "DETROIT." Thousands in use. Costs only postal to find out. If you are first in your neighborhood to write, we will allow you **Special Extra-Low Introductory** price. Write!

Detroit Engine Works, 311 Bellevue Ave., Detroit, Mich.

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LITTLE YANKEE

A REAL IRRIGATION MACHINE

With all the features of a practical

Grader
Ditcher
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Cut showing diggers and fenders attached. These can be removed and the blade set for lateral ditching in five minutes.

BLADE COMPLETELY REVERSIBLE

WHEELS FITTED WITH FLANGED RIMS AND DIRT PROOF BOXES

Lightest draft. No weight on horses' necks. A "snap" for teams and operator

Write Us.

THE OHIO ROAD MACHINERY CO.
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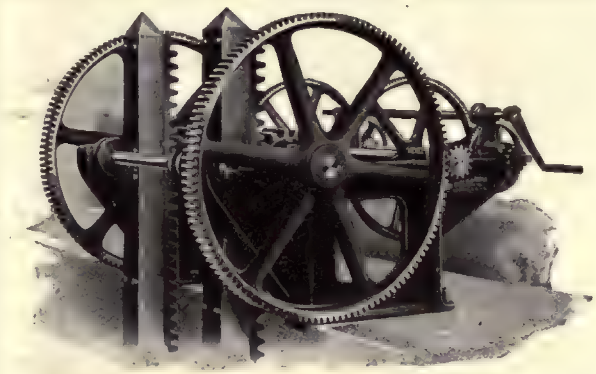

The accompanying illustration shows our No. 7

Head Gate Hoist

This is a heavy compound geared type for double sterngate raised under pressure. Recent head gate installations include

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The Dayton Globe Iron Works Co.
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Send $1.00 for The Irrigation Age one year, and The Primer of Irrigation

The Temple Irrigation Equipments the most Economical and Certain Means of Lifting Water

55 YEARS' EXPERIENCE

Write us for Information and Prices—State Requirements

CENTRIFUGAL PUMP AND GASOLINE ENGINE IRRIGATION OUTFIT

The Temple Water Elevators—The Temple Centrifugal Pumps

Manufacturers of all kinds of Hand and Windmill Pumps

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Briefly stated the advantages of our Double Cylinder Engines are as follows:

First—They are more economical in the use of fuel. On light loads one cylinder can be used, reserving both cylinders for heavy loads.

Second—Although weighing about one-half the weight of a single cylinder engine of same rated capacity, vibrations are practically overcome, demonstrating conclusively that in proportion to strain, the double cylinder "Master Workman" is the stronger engine.

Third—The heavier weight of a single cylinder engine is due to the fact that it must have heavier fly wheels in the horizontal type, and a longer, higher and consequently much heavier base than is required for the "Master Workman." The heavier the fly-wheels the greater the strain on the crankshaft, so you will realize that neither heavier fly-wheels nor a heavier base contribute one iota to the strength of a single cylinder engine.

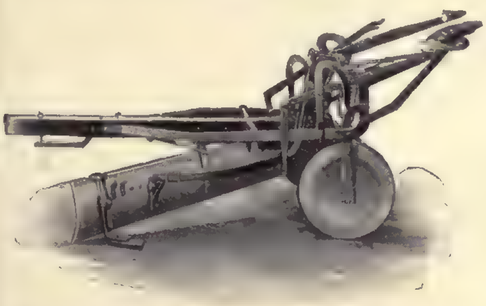
Fourth—When vibrations are overcome, as in the "Master Workman," the lighter the engine and the less cumbersome it is, the greater its sphere of usefulness and the cheaper and more convenient it can be handled.

Fifth—Lubrication in our engine is absolutely perfect. There is no forced lubrication, lubrication being by gravity. Certainty of lubrication is of vital importance in the steady running and operation of a gasoline engine.

Sixth—All mechanism is in full view, which will enable you to thoroughly understand the operation of a gasoline engine. The worst kind of complexity is concealed mechanism.

THE TEMPLE PUMP CO., **Factory, 15th St. and 15th Place, near Canal St. Chicago, Ill., U. S. A.**

Here's What the 20th Century Will Do for You



Notice Grader has only two wheels. Both behind blade.

Slash off sage brush—
Level fields for irrigation—
Cut laterals for irrigation—
Cut side ditches—
Make shallow drainage ditches—
Clean laterals and throw borders—
Move dirt and drop it anywhere—
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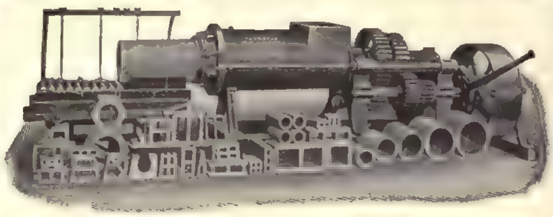

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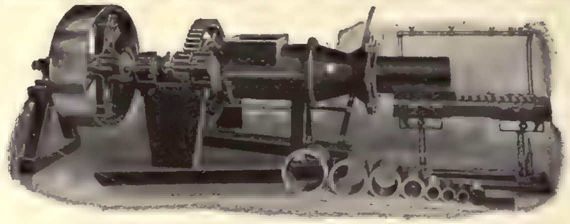

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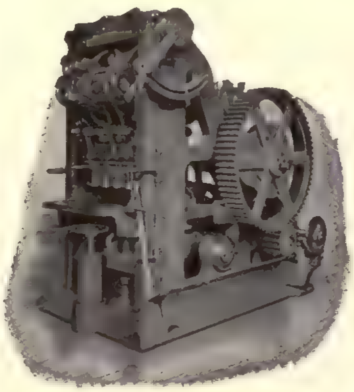

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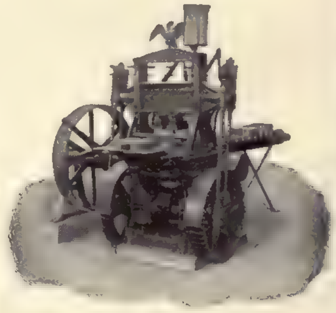

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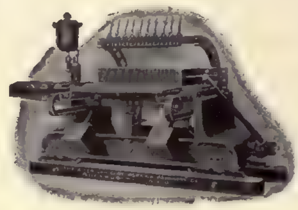

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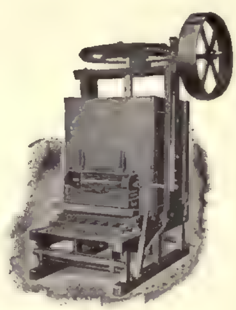

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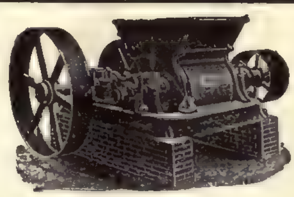

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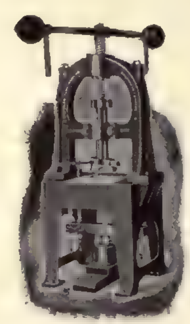

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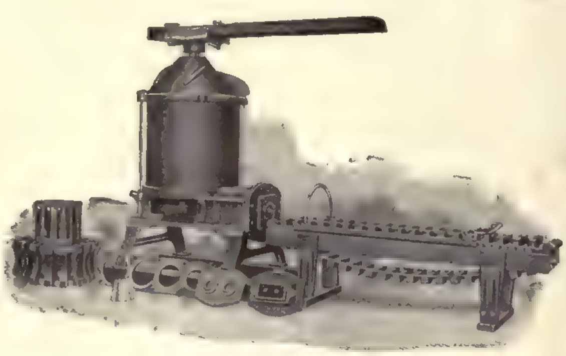

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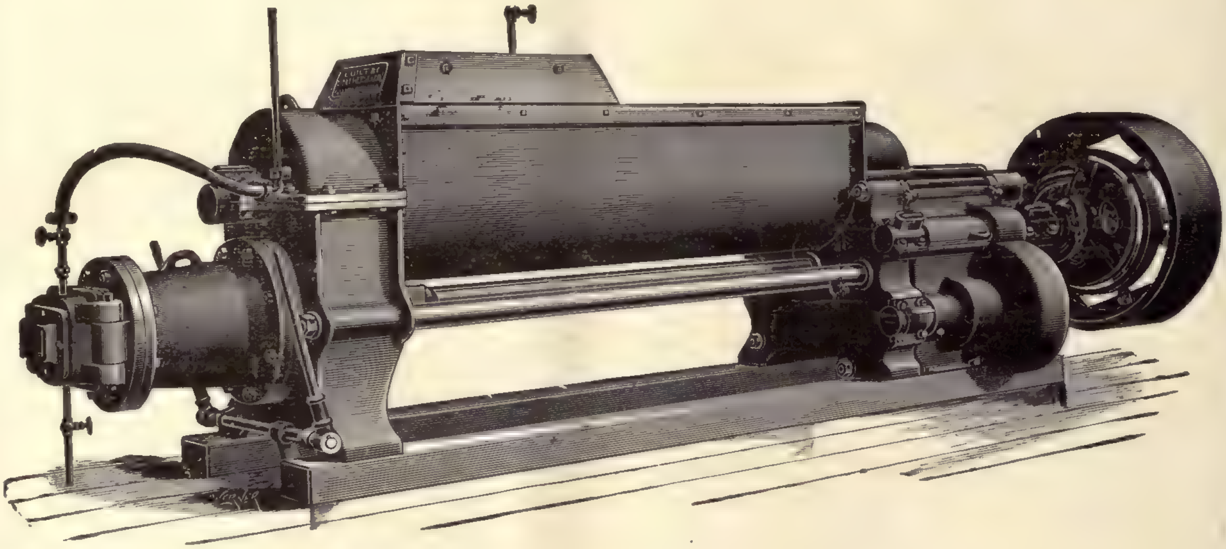

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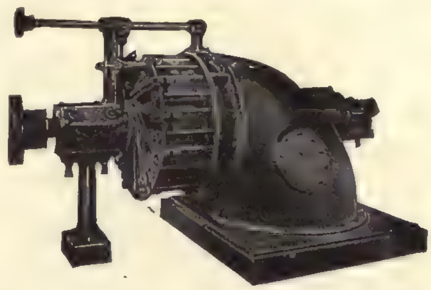

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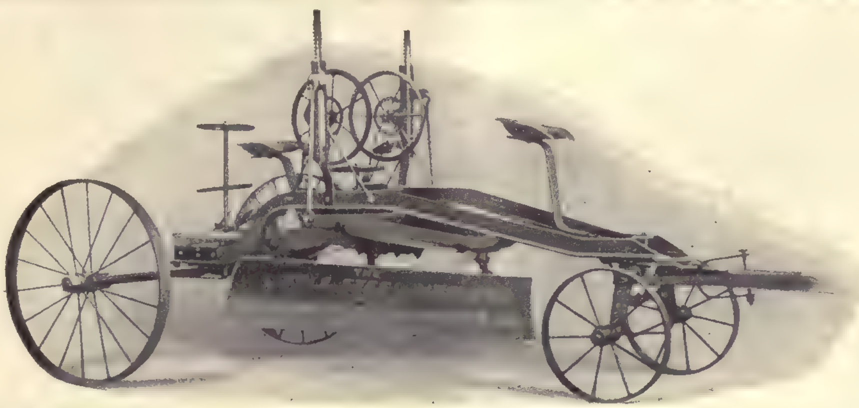

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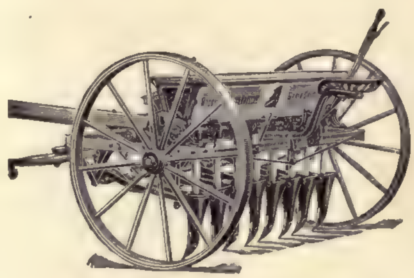

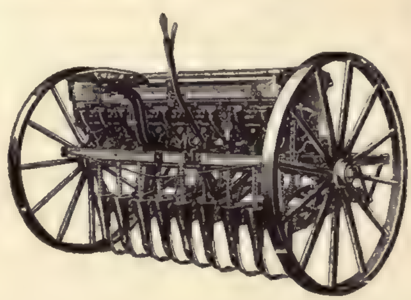

Twenty-sixth Year

THE IRRIGATION AGE

VOL. XXVI CHICAGO, JUNE, 1911. NO. 8

THE IRRIGATION AGE

With which is Merged

MODERN IRRIGATION THE DRAINAGE JOURNAL
THE IRRIGATION ERA MID-WEST
ARID AMERICA THE FARM HERALD

D. H. ANDERSON
PUBLISHER,

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CONTENTS.

The Standard Oil Case

Few decisions rendered by the Supreme Court of the United States have attracted so much and so widespread attention as the one recently given in the celebrated Standard Oil Case, in which, although the Standard Oil Trust was ordered to dissolve, yet the Court by the interjection of the word "unreasonable" in conjunction with "restraint of trade" has built a dangerous legal breastwork behind which all kinds of trusts will be able to find refuge. For if the Standard Oil Co was disolved on account of "unreasonable" restraint of trade, who shall be judge to declare whether some other trust is interfering with interstate trade in a reasonable or unreasonable manner?

As announced by the daily press, Justice Harlan dissented from the other eight members of the Supreme Court, and a very lengthy dissenting opinion has been made public by him in which the court is censured for interfering with the people as the source of all legislative power. The text of the opinion is too long to be given here, but the principal points are given in the following:

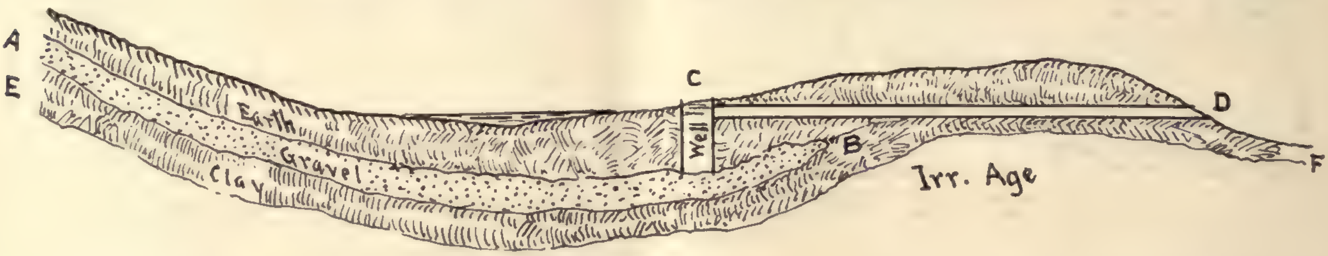
"When Congress prohibited every contract, combination or monopoly in restraint of commerce it prescribed a simple, definite rule that all could understand and which could be easily applied by everyone wishing to obey the law. But now, it is to be feared, we are to have, in cases without number, the constantly recurring inquiry difficult to solve by proof—whether the particular contract, combination or trust involved in each case is or is not an 'unreasonable' or 'undue' restraint of trade.

"Congress, in effect, said that there should be no

restraint of trade in any form, and this court solemnly adjudged many years ago that Congress meant what it thus said in clear and explicit words and that it could not add to the words of the act. But those who condemn the action of Congress are now, in effect, informed that the courts will allow such restraints of interstate commerce as are shown not to be unreasonable or undue.

"The supreme law of the land, which is binding alike upon all—upon presidents, congresses, the courts and the people—gives to Congress, and to Congress alone, authority to regulate interstate commerce, and when Congress forbids any restraint of such commerce, in any form, all must obey the mandate. To overreach the action of Congress merely by judicial construction—that is, by indirection—is a blow at the integrity of our governmental system and in the end will prove most dangerous to all."

It would seem plain to an ordinary man that there can be no such thing as a reasonable restraint of trade no more than there could be reasonable or unreasonable stealing or murdering; there may be degrees in wickedness, but let us call things by the right name and not try to find excuses for wrongs, whether committed by a billion dollar corporation or by the highwayman at the point of a gun.



A Common Drainage Problem Analyzed

Where land requires drainage it is necessary in most cases to make a study of all the conditions involved in order to reach the best and most satisfactory solution to the problem. The essential thing is to to get the surplus water from the land in the most economical manner. Of course in many cases when the topography simply indicates a ditch or drain to a water course, a line of levels run will quickly point the way for the ditch or tile and the problem is solved.

There are, however, other and more complicated problems encountered which require more and considerable study and investigation. This is particularly true with seepage water where the water follows water-bearing strata under ground such as sand and gravel for long distances and when these strata end abruptly the water will rise to the surface and form a swamp. An assumed case of this nature is illustrated in the accompanying sketch, which represents a typical section through land in which the geological strata are shown, the upper layer being ordinary soil, then comes a layer A B of gravel inclined toward B where it abruptly terminates; below this gravel stratum there is a layer E F of impervious clay.

It is easily seen that the water which follows the vein of gravel when it reaches the point B will have to back up as the layer of clay below will not permit its flow to the natural water course at F. The water in consequence presses upward and as the soil on top of the gravel offers less resistance it percolates through it and stands on top of the ground to a more or less extent depending on the amount of water carried by the gravel stratum and the pressure which is exerted by the elevation of A over B.

To drain a swamp of this nature the best method will be as outlined in the sketch. The nearby water course F is the starting point and a line of levels should be run from F to C, and the well C should be so located that the ditch or drain C D will have sufficient fall to carry off the water. If a smooth tile be used to drain the swamp a fall of 3 inches per hundred ft. will be sufficient. The well C should be sunk as near the end of the gravel layer at B as possible so that the position shown in the sketch is not exactly correct since by moving the well toward B the length of the drain C D is shortened, which is an advantage. A ditch should also be cut from the lowest point of the swamp into the well which will drain off the surface water; the water which is contained in the gravel layer A B will now rise in well C quite readily and flow off through the drain C D into the natural water course.

The above analysis shows how necessary it is to approach all problems of irrigation and drainage intelligently. A few dollars spent, or sometimes only a few hours time of investigation will bring splendid results. It is just such work of study and investigation which has wrought the tremendous changes in the arid west and the swamps of the South; of course when capital stands ready to support the brain and brawn of the country the results are large and comprehensive, according to the large units involved. Thus the reclamation of 100,000 acres of swamp land by the introduction of a million dollar plant consisting of dredges, pumping plants and channels causes much comment and is heralded over the whole world.

Now, if 10,000 farmers should each reclaim 10 acres of swamp on his own holdings in the manner indicated above the results would be more beneficial since the hundred thousand acres restored would benefit 10,000 families directly instead of a corporation which would use the land so restored perhaps by asking unreasonable and prohibitive prices. At any rate there should be no farmer in this country nor anywhere else who has waste land on his domain without making efforts right away to turn the same to use; if the land needs drainage to set at once about the task to provide it and to do so by studying out the best and most economical method.

Hydraulics is a Necessary Study in Irrigation

The Primer of Hydraulics will be ready in book form on or about January 1st, 1912. It will be a splendid book for any one interested in irrigation or drainage. Its price will be $2.50 net for cloth bound copies; it will however be sold for $2.00 a copy to all those who renew their subscription to the Irrigation Age or to new subscribers to the Irrigation Age if they send $3.00 for the Primer of Hydraulics and the Irrigation Age for one year.

The primer of Hydraulics is the first technical book which has been designed for the use of the everyday practical business man, mechanic and irrigationist on this subject. A knowledge of the principles of hydraulics is indispensible for any one interested in reclamation or irrigation, and here is an opportunity to obtain that knowledge at small cost and some study.

Some hints were given in a former issue how to study the "Primer of Hydraulics" to obtain the best results, and the author will be glad to help every one who is interested.

A Sketch is a Very Useful Thing

In a recent publication by the State Agricultural College of Colorado appears an article entitled "Small Concrete Weirs for the Farm." The article goes quite into the details of construction, describing methods and giving sizes of ditches and excavation, the lumber for the forms and sizes of reinforcing rods to be used as well as the proportioning of the concrete.

The article, which is no doubt very useful and is full of practical suggestions, would be of much greater value if a diagram or sketch had been added in which the work described would be shown as one assembled unit. Then the illustration with the description would give all the data required for the utilization of the plan. As it now appears it would be a very difficult proposition for any one to build such a weir as indicated by merely following the verbal description given.

The Water Resources of San Luis Valley, Colorado

Elsewhere appears a lengthy article on this subject which has been abstracted from a water supply paper of the United States Geological Survey. There is so much good material contained in this government report and so much useful information and instruction for men interested in irrigation that we feel sorry that want of space forbids to publish it in full. But even in its abbreviated form our readers will doubtless derive benefit by its study and those who desire to have the report in full may obtain it by writing to the United States Geological Survey, Washington, D. C.

Further installments of this report, very much abbreviated, will be published in the IRRIGATION AGE in the July and August issues.

The principal impression gained upon reading this report is the thoroughness with which the subject has been handled and the clear and concise statements of Mr. Siebenthal of the elements, affecting the water supply of the San Luis Valley.

An especially interesting feature is shown in Figure 2 of that article when by the installation of a small pumping outfit a strong flow of water was produced by tapping an abundant underflow of water. The knowledge obtained by the Geological Survey pointed the way for this improvement. Our readers may think for themselves how many similar cases there may be in this wide land, where like conditions exists but for the want of information nothing is done for bettering things.

This shows the necessity that the government not only should keep up the work of the Geological Survey but that Congress should increase the appropriations for this purpose and that this work be pushed until all the available land for reclamation or for other uses has been investigated and the information published for the use of the public.

The Prevention of Forest Fires

The time of the year is approaching now when this country of ours usually suffers great loss due to forest fires. These conflagrations of late years have been so extensive and accompanied by such heavy losses both in lives and money values that our western people are waking up to the importance of the matter and are going to do something in this direction. On another page will be found some seasonable suggestions by the Western Forestry and Conservation Association in regard to this subject and it is hoped that the public will co-operate and make the work of the association effective.

Chips from the Thinking Cap of the Editor

Three dollars will pay for one year's subscription to the IRRIGATION AGE and a copy of the "Primer of Hydraulics," bound in cloth; the book will be ready about January 1, 1912.

* * *

Renew your subscription promptly—one dollar does not mean much to the individual reader but 2,000 or 3,000 tardy subscribers means a good deal to the publisher; it means 2,000 or 3,000 dollars tied up that ought to be available.

* * *

Letters from our readers and subscribers are always welcome. All are invited to make use of the columns of our correspondence department. Especially letters from the men in the field who are putting in the ditches and the grain will be particularly welcome.

* * *

The man who is in the front rank of the irrigation and reclamation column is most competent to pass judgment on the value of methods adapted to bring waste lands to the stage of productiveness; let us hear from you and give our readers the benefit of your large experience.

The Bars Are Let Down

From the *Valley Irrigator* of May 4th we learn that the Assistant Commissioner of the General Land Office has reversed the decision of the Local Land Office and has ruled that a corporation may obtain water rights even though the stock holders do not reside within fifty miles of the land. The test case in question is that of the Chamberlain Investment Company, nearly all the stockholders of which live in Huron, S. D., which applied for water rights for an eighty-acre tract. Their application was rejected by the local office on the ground that the stockholders did not live within fifty miles of the land. An appeal was taken to the general office. The decision of the latter in reversing the ruling of the local office is based upon a former ruling of said general office in which it was held that a private corporation is entitled to make a water right application if its principal office is on or in the neighborhood of the land for which water is sought, and further that the corporation must show a list of its stockholders, and that as individuals they have not taken in the aggregate more water rights than what will amount to 160 acres. Theoretically this sounds all right and if so correctly followed would not be an infraction of the "Reclamation" act. This will, however, be extremely difficult to watch properly and under this ruling hundreds of corporations will no doubt be formed to take up land which, under the act of June 17, 1902, was intended for actual settlers only.

There should be made no interpretations of the Reclamation act which will defeat the intention of the law.

Section 5 of the act provides, among other things, "that * * * no such sale shall be made to any land owner unless he is an actual, bona fide resident on such land, or occupant thereof, residing in the neighborhood of said land."

This provision seems plain and ample and should bar any corporation from being eligible under this act.

Geology and Water Resources of the San Luis Valley, Colorado*

By C. E. Siebenthal

The San Luis Valley, having an area comparable to the State of Connecticut, lies in the south-central part of Colorado (fig. 1), with a narrowed southern end reaching into New Mexico about 15 miles. The whole length of the valley from north to south is about 150 miles and its greatest width about 50 miles. The San Luis Hills, a series of basalt-capped table-topped mountains extending from Antonito in the direction of Fort Garland, separate the valley into two portions. It is with the northern part, containing the artesian basin, that we have to do. This partion of the valley is limited on the east by the majestic Sangre do Cristo Range, on the west by the Sawatch and Conejos ranges, and on the south by the San Luis Hills.

The salient features are the bold Sangre de Cristo Range and the less abrupt Culebra Range on the east, the gentler eastward-sloping Sawatch and Conejos ranges on the west, the flat-topped San Luis Hills on the south, and the almost flat surface of the valley itself, the trough of the valley lies far east of the median axis—close under the Sangre de Cristo, in fact. From the trough the country rises to the foothills, more steeply eastward, very gently westward, at first not more than 3 to 6 feet to the mile, but gradually increasing until near the foothills the rise is quite perceptible to the eye. The extreme flatness of the valley is shown by the great distances for which the canals are constructed along straight lines. The Prairie ditch and the laterals of the Farmer's Union canal and the Del Norte canal run from 10 to 25 miles on straight east and west lines, with branches north and south at right angles.

So nearly level is the valley floor that its essential character entirely escapes one traveling over it, and it is only when brought out by a topographic map that it becomes clear. In such a map, however, the alluvial-fan structure of the valley floors is strikingly manifest. Each stream descending from the steeper slopes of the mountains to the valley has deposited its spreading fan of gravel and sand. Around the west and south sides of Blanca Peak these alluvial fans are especially prominent. They are so close together that they coalesce along their lateral margins to form a steep, gravelly alluvial slope skirting the foot of the mountain. The streams coming down from the west range, having a much lower gradient, can carry neither such heavy material nor so much of it, and as a consequence have built up much flatter fans, though the form of the fans is no doubt chiefly due to the fact that, except for the surface veneer of gravel and sand, they were deposited in water, as shown by the continuity of the clay and sand beds of the Alamosa formation. However, La Jara, Alamosa, and Cat creeks have built up pronounced fan deltas. But the map shows at a glance that the Rio Grande has built the most extensive fan of all and, for the reason given above, the flattest. It is also clear that the trough of the valley lies so far to the east because the encroaching fan has pushed it there, and that the sluggish character of San Luis Creek has resulted from the filling in of its lower course by the same agency. Conejos River has built a long fan partly confined between the Mogotes Mountains and the San Luis Hills, and partly extending south of the San Luis Hills into New Mexico, and must have discharged or at least sent distributaries at times to the south of the San Luis Hills. Saguache Creek has likewise a fan delta, but one rather poorly developed. San Luis Creek, taking its source in Poncha Pass not much above the level of the valley itself, naturally could develop no fan.

The streams in the valley proper have cut their valleys to various depths, but all are shallow. The bank of the Rio Grande at Monte Vista, where the oldest terrace comes to the river, is 20 or 30 feet high. At Alamosa the bank is from 8 to 12 feet high. The other streams have banks varying from a few inches to 4 or 5 feet high.

At different places in the valley there are bluffs which are not now adjacent to streams but which represent the margins of abandoned courses of the streams in their wanderings over the alluvial fans and slopes after the emptying of the lake which filled the valley during the deposition of the Alamosa formation. One passes through Sanford, two are near Henry station, and one northwest of Hooper. They vary in height, but are mostly not far from 10 feet.

Stretching from Washington Springs south to the mouth of Trinchera Creek is a bluff bank which culminates opposite the Hansen ranch and has for that reason been called the Hansen Bluff. It here reaches a height above the Rio Grande of 60 feet. The level country stretching away eastward from its top represents the level of the valley bottom at the time when the water cut down the divide in the San Luis Hills and began to drain the lake that originally occupied the center of the valley. The original course of the river was probably somewhat west of its present course, but the alluvial fans of the streams on the west side of the valley have continually pushed it eastward and caused it to undercut the bluff.

The Rio Grande enters from the middle of the west side, pursues a southeasterly course to the San Luis Hills, and leaves through a defile in them. A number of tributary streams, notably Conejos River and La Jara, Alamosa, and Saguache creeks, flow down from the Conejos and Sawatch ranges, whose more gentle slopes gives room for extensive drainage areas. Arms of the valley extend for some distance up the course of the Conejos, the Rio Grande, and the Saguache, while a long, narrow arm, extending northward to Poncha Pass, the upper end being known as Homan's Park, is drained by San Luis Creek. The surface configuration of the valley is such that this creek should receive all the water entering the valley on either side, north of the Rio Grande, but as a matter of fact most of the drainage, especially that of the eastern range, is lost by seepage before it reaches the creek, or reaches it only in flood season. The creek itself in its lower course develops a series of wet-weather ponds and finally flows into the San Luis Lakes. The old overflow drainage course to the Rio Grande still exists but has been so blocked and concealed by incipient sand dunes as to be very difficult to trace except in its general features.

A gauging station has been maintained for many years at Del Norte, where the Rio Grande enters the San Luis Valley, and above the head-gate of the uppermost of the valley irrigation system. Another one was maintained for a long period at Embudo, N. Mex., at the lower end of Embudo Canyon, into which the river flows just before crossing the Colorado-New Mexico line. From 1899 until 1904 a station was also maintained at State Bridge, at the upper end of Embudo Canyon. This station, situated but a few miles below the cultivated area of the valley, was of great importance in determining the volume of water left in the river after the valley irrigation, and the discontinuance of this and the Embudo station is much to be regretted.

At this point it may not be amiss to call attention to some facts bearing on the interstate relations of irrigation in the San Luis Valley. Agriculture and irrigation spread up the Rio Grande Valley from Mexico and Texas, through New Mexico to San Luis Valley in Colorado. With the rapid expansion of irrigation in the San Luis Valley the water of the Rio Grande was largely withdrawn in Colorado, to the alleged great detriment of agriculture on the lower course of the river. The question of prior rights to the use of the water became a subject for interstate and international discussion. Major Powell in 1890, testifying before the Senate Special Committee on Irrigation and Reclamation of Arid Lands, said:

Passing into New Mexico, then, the water that practically heads in the high mountains of Colorado is largely, almost wholly, cut off from the Rio Grande, so that no portion of the water that heads in these mountains where there is great precipitation will cross the line into New Mexico (in the dry season). * * * In a dry season nothing can be raised in the lower region and sometimes dry seasons come two or three together.

Nevertheless, Major Powell argued that it is advantageous that the water in a stream be used for irrigation as near to its source as possible, since there the duty of water is greatest and the loss from evaporation and seepage is least.

In the valley of the Rio Grande the greater portion of the water during the season of irrigation is lost in the sands, as in the valley of the Arkansas. If the water of the Rio

*Abstract from water supply paper 240, of the Department of the Interior United States Geological Survey.

Grande is compelled to flow across the line from Colorado into New Mexico, it will destroy from 1,000,000 to 1,500,000 acres of agriculture above in order to save 200,000 or 300,000 acres in the valley below.

Major Powell urged that the tributaries of the Rio Grande below the Colorado-New Mexico line would, if the water were conserved, furnish a sufficient flow to maintain the irrigation of that section as then developed. He pointed out that "when the river emerges into the valley at the foot of Embudo Canyon it is a fine stream and *must always be so whatever water is taken out in Colorado above.*" That this somewhat startling and paradoxical statement is borne out by the facts is indicated in the following paragraphs, where the explanation is suggested.

The great excess of water wasted during the flood season and the frequent lack of water when needed have turned attention to the possibility of reservoirs in the upper course of the streams to conserve the flood water and have led to search for available sites. Naturally those first sought are the ones requiring the least expenditure of money to make them available. The head branches of most of the larger streams emptying into the valley held glaciers of various size during past ages, and many of the morainic dams and terraces resulting from glacial action offer tempting sites for storage reservoirs. Such formations require most careful testing, because from the nature of their material they will not, as a general rule, hold water after it has accumulated in volume sufficient to cause much pressure. But doubtless there are numerous sites in the various streams that will serve admirably. Such are reported on Alamosa Creek and in the upper course of the Rio Grande. One of those on the Rio Grande has been thoroughly tested by the company operating the Rio Grande and Monte Vista canals, and a reservoir is now under construction.

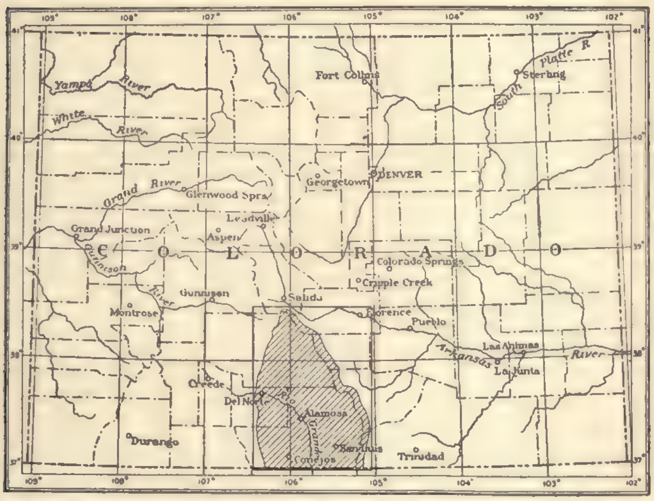


FIGURE 1.—Outline map of Colorado, showing location of San Luis Valley.

The high gradient and the small drainage areas of the streams coming down from the Sangre de Cristo Range preclude the establishment there of any but small irrigation systems. On the other hand, the low gradient and large drainage areas of the streams entering from the west side of the valley are very advantageous to large systems. Toward their headwaters these streams branch out and their valleys take on the rolling character of glaciated cirques and are heavily covered with pine and spruce. The timber, by checking the run-off in time of heavy rains and by protecting the snow from rapid melting, controls the discharge of the streams and to that extent does away with the necessity for storage reservoirs.

IRRIGATION.

Canals.—The full flows of all the streams entering the valley are appropriated for purposes of irrigation. The Rio Grande is the main source of supply. The following table shows the total appropriations and dates of the main priorities of the principal canals and ditches taking water from that streams, as decreed by the courts in 1900:

Water appropriated for principal ditches and canals from the Rio Grande, and total decreed appropriation.

Priority.	Canal.	Appropriation. Cubic feet.
1874 and 1879	Centennial ditch	82.4
1881 and 1891	Rio Grande (Del Norte) canal	905.6
1882 and 1889	Monte Vista (Citizens') canal	257.8
1882 and 1890	Empire canal	667.5
1885	San Luis Valley Canal	92.9
1886	Costilla ditch	103.3
1887	Prairie Ditch	105.1
1887	Farmers' Union canal	138.8
	Total of principal ditches and canals	2,353.4
	Total appropriation decreed by court to 1900	3,022.59

The foregoing table, when compared with the table giving the average monthly flow of the Rio Grande from April to September, inclusive, for sixteen years shows that the waters of this stream are greatly overappropriated, even in the flood season.

Average monthly discharge of the Rio Grande at Del Norte, 1890-1905.

	Second-feet.
April	968
May	2,505
June	2,605
July	864
August	474
September	404

Acres irrigated from the Rio Grande and tributaries.

County.	1899.	1889.	Per cent. increase.
Hinsdale	1,339	1,389	......
Mineral	......	2,640	......
Saguache	75,909	52,453	44.7
Rio Grande	71,325	21,797	227.2
Costilla	50,290	25,918	94.0
Conejos	98,486	46,273	112.8
	299,989	147,830	102.9

This acreage is confined to the San Luis Valley, except perhaps 10,000 acres lying on the upper courses of the river or its tributaries.

Between Mosca and Hooper is a region in which the supply of ditch water for several years has been inadequate, and here was developed the scheme of installing a gasoline pumping plant and pumping from the underground water level as raised and maintained by subirrigation. No change in the application of the water thus gained was proposed. It was to be used in subirrigating; that is, the level of underground water was to be raised by adding to it water taken from it—another statement of the problem of raising one's self by one's foot straps. The application of the water might be changed by the substitution of surface irrigation for subirrigation methods, thus doing away with the necessity of keeping up the underground water level; but a difficulty appears in that case. The interesting question is raised as to the right of one person to lower the water level when his neighbors, in the customary practice of irrigation, are under the necessity of keeping it up.

Many of the smaller streams on either side of the valley run out into the valley during the flood season but during the remainder of the year, except for short intervals, disappear beneath the gravel, where they emerge from the mountains at the upper edge of the alluvial slope. But by digging down a few feet in the rocky channels of such streams a persistent and heavy underflow is encountered. It is possible by installing a gasoline pumping outfit to raise this underflow and irrigate successfully when the water is not running in the streams. One such pumping outfit has been in successful operation in 1903 and 1904 by Mr. K. Eilinghoff 2 miles east of Chamberlain Hot Springs. The equipment consisted of a 3½-horsepower gasoline engine and a 2-inch centrifugal pump with a normal discharge of 125 gallons per minute. The water was taken from a well 16 feet deep, in which the water stood within 7 feet of the surface but with steady pumping sank to 11 feet from the surface, where it remained.

The cost of installing such an outfit is not large, and the cost of operating for the short time it would ordinarily be in use, at critical periods in the growth of the crop, will also

be small, so that there seems to be a genuine need for such plants, particularly in the northern portion of the valley and wherever else the supply of ditch water is short and the underflow sufficient.

Where the underflow may not be adequate with a simple well, a subterranean gallery will be found more efficacious. The accompanying plan (fig. 2) of the city pumping plant of Castle Rock, Colo., may be advantageously copied in designing outfits of this sort.

Canvas flumes.—Along the west slope of the Sangre de Cristo Range many streams afford water that is sufficient to irrigate small tracts but in the irrigation season is entirely lost in passing over the alluvial slope at the foot of the range. A plan adopted by the placer miners of Alaska, and used in irrigation in California, might possibly be worked here to advantage. At some places in Alaska water is carried on the surface of the ground for miles in a flume made by sewing together the two sides of a strip of cotton duck canvas, making a long canvas pipe. Or the bottom of a ditch may be lined with such canvas. The cloth will be less subject to damage by cattle and rodents, however, when sewed up in the form of a hollow cylinder and filled with water. Such a flume might conceivably last for several irrigation seasons of a couple of months each. A subsurface dam across the canyon near its discharge upon the alluvial slope would help by bringing all the underflow of the stream to the surface at the intake of the flume.

AGRICULTURE.

The first population of the San Luis Valley was Mexican, and the little Mexican "plazas" are scattered along both sides of the valley but are more numerous in its southern part. The Mexican constructed no large irrigation ditches, and their settlements were perforce limited to the mountain valleys, to the border of the San Luis Valley, and to the immediate banks of the perennial streams in the valley.

Following the advent of Americans came colonization schemes and the construction of large canals, permitting the central part of the valley to be settled. North of the Rio Grande the country adjacent to the railway, irrigated by the Farmers' Union, Prairie Ditch, and San Luis canals, were first settled in preference to the more gravelly soil to the west. Gradually, however, the gravelly land was found to be fertile and suited to cultivation as well as the other, and the cultivated territory spread farther westward. Then, from a combination of causes, the land that lay to the east along the railway and was the first to be cultivated was practically abandoned. These causes were (1) exhaustion of the soil by continuous cropping without rotation; (2) exhaustion of the water in the canals by farms nearer the heads of the canals; (3) failure of the canals in years of drouth through lateness of their priorities; (4) injurious accumulation of alkali in the soil. This accumulation of alkali is due to the prevailing practice of subirrigation. The alkali is largely of local origin, a result of the concentration at the surface of the salts in the soil of the affected region itself, but is also partly derived from the soil of the contiguous and higher regions to the west and carried by seepage water to the lower land, there coming to the surface and being precipitated.

Remnants of the population brought in by colonization schemes exist in different parts of the valley, as, for instance, settlements of French Canadians about Carnero, of Scandinavians at Swede Corners south of Saguache and in the neighborhood of Swede Schoolhouse southwest of Alamosa, and of Mormons at Manassa, Sanford, Richfield, Freedom, and, until recently, at Zapato.

The native vegetation of the valley varies with the region and the ecologic conditions. On the high mountain sides pine, aspen, and spruce, lower down piñon and cedar, and in the valleys and along streams cottonwood and willow constitute the forest growth. The valley bottom away from streams is covered with a growth of "chico" and "greasewood," the former predominating in adobe soils and both growing in the loams. Sagebrush does not grow in the valley bottom but is found in the foothills in places. Wild currants and raspberries thrive abundantly, growing well up the mountain slopes. Of the currants three varieties are found, black, red and yellow.

Much native hay is grown along the bottoms of the streams that come down into the valley from either side. These vegas, or native meadows, were among the first tracts taken up as homesteads, and on account of their value and the ease of cropping are not plowed up to be planted in other crops unless they run out. The market for hay is largely local, yet some is shipped.

The principal crops are wheat, oats, wild hay, alfalfa, potatoes, peas and barley. Wheat was the first crop and is the most important crop today. Very little trouble was taken in planting wheat by the early settlers. The brush was uprooted by dragging a heavy railroad rail across the land, raked up into windrows and burned, and the wheat drilled in directly without plowing. Such methods sufficed to get large yields and led to the planting of large acreage and the building of mills and elevators at Del Norte, Monte Vista, Hooper, Mosca, Alamosa, La Jara and Conejos. In time the heavy wheat returns failed and crops were rotated, or the fields were planted in alternate years, lying fallow in the intervals.

In the last few years, however, a new industry has sprung up, which yields good returns and which, in the long run, will be more valuable, in that it will restore the land to its pristine fertility. This is the business of fattening young lambs for the spring markets. Quarter sections are grown with peas, or a mixture of peas and oats, and the lambs are pastured on these, thus at one stroke doing away with the need of harvesting the crop and hauling it to market, besides resting the land by raising a leguminaceous crop and returning nearly all the mineral plant food to the soil. The practice promises to spread rapidly and will unquestionably make for the good of the valley. The meat of lambs fed on peas is said to be much improved in flavor and at all times commands the best prices.

The late and short growing season in the valley of necessity cuts out some fruits and crops. Early corn will in a favorable year make small roasting ears. Apples and pears have grown in protected places, but these are unimportant and fruit is mostly imported from the outside.

Methods of Irrigation.

In the San Luis valley the method of irrigation practiced almost universally is a modification of subsurface irrigation, locally known as "subirrigation." In subsurface irrigation the water is carried in underground tile or perforated pipe directly beneath the roots of the plant to be irrigated, as, for instance, beneath a row of fruit trees. In subirrigation, as practiced in the valley, the water is conducted onto the field in trenches at such distances apart as experience and the character of the soil shall determine. These trenches are closed at the lower ends and water is supplied to them only so fast as it is taken up by the sides and bottom of the trenches, care being taken to prevent overflowing. The loamy character of the soil allows it to absorb the water rapidly, while the level character of the surface permits the raising of the level of ground water to a height within reach of the rootlets of the growing crops. The object in view is to keep the level of the underground water at this height. If the spring rains have not left the water level near the surface, it may be brought so by a preliminary flooding.

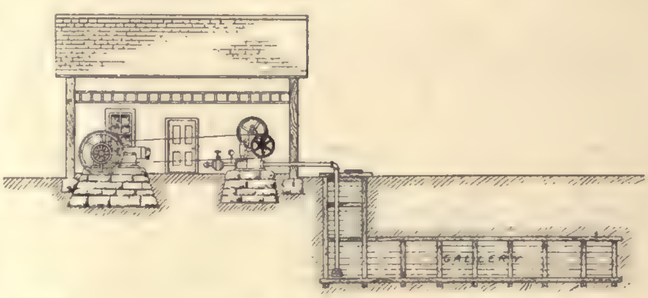


Fig. 2.—Plan of Pumping Plant Showing Subterranean Gallery.

This method requires much less care and trouble than the method of flooding or surface irrigation, and is as efficacious as that method, though it requires much more water. Its long-continued practice, however, brings a result that is detrimental; that is to say, it renders the soil alkaline. In countries of greater rainfall, where irrigation is not needed, the constant flooding of the soil since its formation as a result of heavy rains and the consequent run-off

has leached from it much if not all of its content of injurious salts, as well as much of the mineral matter needed as plant food. For the same reason, in the so-called arid regions, correlated with the liability to become alkaline under careless irrigation is the greater fertility of the land due to the greater abundance of mineral plant food.

The salts which render soil alkaline are, in the order of their injurious effects, sodium carbonate ("black alkali"), sodium sulphate ("Glauber's salt"), and sodium chloride (common salt). These are originally so widely scattered in small particles through the soil and subsoil as not to be injurious. They are very readily dissolved in the water put on in subirrigation, which penetrates both the soil and the subsoil. As this water is drawn to the surface and evaporated, it leaves these salts behind it on the surface of the ground. As a result of this continuous process, the salts are leached from the soil and subsoil and accumulate on the surface of the soil, rendering it in time unfit for tilling. Once in solution, the only way the salts are redeposited in the soil is by evaporation. The remedy is of course to reverse the process of irrigation; that is to say, apply the water at the surface, preferably by flooding, and to withdraw it from below by draining, thus continually carrying away the salts in solution and lessening their amount in the soil. This method, as just pointed out, has the disadvantage of removing from the soil some of its valuable elements.

Not all of the water comes immediately to the surface to be evaporated, especially on the less gently sloping gravelly land of the alluvial-fan formations to the west. A portion of the water continues down the slope as underflowing ground water until forced to the surface by clay beds beneath. Here it issues as a "seep," usually making an "alkali spot."

How short-sighted was the man who congratulated himself because his land required no irrigation when his next neighbor's land above was thoroughly saturated or "subbed." He simply was slowly accumulating a large part of his neighbor's alkali. Perhaps his neighbor in turn was having alkali unloaded upon his land. But the man for whom there is no escaping the alkali under the system of subirrigation is the one on whose place the seep rises to the surface. As noted before, the remedy lies in the surface application of the water, with subsurface drainage, not only greatly lessening the needful amount and making the supply irrigate a larger territory, but carrying away the alkali.

The report referred to above, based on careful study of the valley, concludes that the amount of alkali in the valley is nowhere so great as to preclude successful reclamation by proper methods.

The East Ranges.

Commencing north of Poncha Pass, the Sangre de Cristo range forms a true sierra extending southeastward and culminating in the massif of the Sierra Blanca group of peaks. The sky line, formed by a series of pointed peaks with intervals of sharply serrate and jagged crest line, and the precipitous front, rising abruptly from the level plain to the height of a mile, combine to make this range one of the boldest and most majestic in the country.

The geologic boundaries in this range, as laid down on the Hayden map, are very much at fault. Only the most cursory examination has been made of the range, which has been ascended or crossed by geologists but a few times at most. The formations involved, so far as known, are basal gneiss, schists, and granite; intrusive granite; quartz conglomerate; pudding-stone conglomerate and red sandstone; and limestone and shales. The ages assigned to these formations by the Hayden geologists are as follows: Gneisses, schists, etc., Archean; pudding-stone conglomerate and red sandstone, upper Carboniferous; and limestone and shales, lower Carboneriferous.

Reference has been made to the occurrence of limestones and sandstones in the vicinity of Villa Grove. The outcrops, as laid down on the Hayden map, show lower Carboniferous rocks facing the valley and upper Carboniferous behind and above. The dip is toward the valley, thus indicating an overturn. On the east side of the valley the same distribution of formations is represented, the upper Carboniferous forming the upper flanks of the Sangro de Cristo Range, the lower Carboniferous restricted to two outcrops on the western foot of the range. This stratigraphic arrangement, taken in connection with the described anticlinal structure of the range, is altogether improbable. Lee has recently shown for the Culebra Range that the limestones marked on the Hayden map as lower Carboniferous are in reality upper Carboniferous and lie on the basal Archean granite, indicating the entire absense of lower Carboniferous; and this is probably true for the whole range except the north end near Salida, where lower Carboniferous limestone carrying fossils with a strong Devonian facies is known. If the same mistake that was made in the Culebra has been made in regard to the age of the limestone east and west of Villa Grove, the structural difficulty disappears and the range is readily interpreted as a great anticline and the valley as a great syncline, the limestone being younger and overlying the sandstones and conglomerates.

In the saddle between Baldy and Blanca peaks is a bed of conglomerate which is quite different from the conglomerate in the north end of the range, in that the pebbles, which rarely exceed 1 or 2 inches in diameter, are all of pure quartz, while the boulders of the Carboniferous conglomerate are large and are made up of all sorts of igneous rocks. This conglomerate in the gap has a thickness of a hundred feet or so, rests on the granite, and has a very ferruginous sandy matrix, the reddish color showing at a long distance. Down Ute Creek the conglomerate is more pronounced in character, and it lies against the foot of Baldy Peak upon the truncated edges of steeply dipping and intruded crystalline rocks. Its apparent thickness is over 100 ft., and the dip is 14° to 16° N. 15° E. It stretches away north of Baldy Peak down the valley of Huerfano river, with a dip of 8° or 10° in a direction north of east. On the north side of the valley the dip of the contact, which from the crumpled condition of the conglomerate seems to be a plane of movement, is 36° in a direction south of east. To the east the dip is more gentle, 20° in the same direction. In the distance down the north side of the valley can be seen bare white patches limestone or light shales. No doubt the upward formations succeeding the conglomerate above would be shown in a section down the ridge in the direction of the dip, and perhaps also the relation of the conglomerate to the conglomerates and limestones of the northern part of the range and of Veta Pass. These relations not having been ascertained, the age of this conglomerate must remain for the present undetermined.

(To Be Continued in July.)

SOME SEASONABLE SUGGESTIONS.

The Western Forestry and Conservation Association, composed of the principal timber-owners and lumber mill operators in California, Oregon, Washington, Idaho and Montana, and headed by Judge Albert L. Flewelling of Spokane, has issued a pamphlet regarding the needs and methods of saving life and property from destruction in forest fires, and urging the observance of the following simple rules:

Don't toss away burning matches or tobacco.

Don't make a camp fire in leaves, rotten wood or against logs, where it may spread or where you cannot be sure it is out.

Never leave a fire until it is out.

Don't burn a slashing in the dry season without a permit and without taking care to keep the fire from spreading.

Put out any fire you find, if you can; if you cannot do so, notify a fire warden, some other public officer or the land owner.

The text of the pamphlet consists of a series of questions and answers, with a view to interesting school children as well as adults in the forest protection movement.

After showing that the states of Oregon, Washington, California, Idaho and Montana contain more than 50 per cent of all the timber in the Union, E. T. Allen, forester of the association, who compiled the data, says:

"Next to food itself, no product is so necessary to the human race as wood. People must have it for fuel, for their houses, barns and fences, to build ships and railroads, and for almost every article used by civilized man. Having plenty of it, we not only get all these things cheaper ourselves, but can sell it to other states and countries which have no forests."

The forests are one of our chief means of support, as lumbering is a great industry. It brings more than $125,000,-

000 a year, or over $332,000 a day into California, Washington, Oregon, Idaho and Montana, and almost all of this immense sum is paid out for labor and supplies, so that every family shares it. It contributes to every business we have, to farmer, merchant, mechanic, and professional man. No other product of these states, not our wheat, our fruit or our wool, furnishes employment for so many people or brings in so much money. Lumber makes up 75 per cent of all the freight we ship out of these states by rail or boat.

The forests keep the flow of our streams even, preventing floods in the wet season and furnishing water for irrigation and power during the dry season; they pay taxes to support our government, our roads and our schools; they shelter our wild game and fish, and in many other ways make our country healthier and pleasanter to live in. In most of our western states, the public schools are supported largely by the sale of timber from state forest lands.

The greatest danger for the destruction of our forests is by carelessly burning them. Although not always as serious as they were last year, forest fires destroy on a yearly average in Oregon, Washington, Idaho, Montana and California timber, which, if saved for manufacture, would bring in $40,000,000. We not only lose this income, but have to pay higher taxes on the rest of our property and higher prices for the forest material which escapes. These fires kill the young trees, so new forests cannot follow the old ones, and, by leaving the ground bare, also hasten the rapid run-off of snow and rain and make our streams low in summer. Often the fires destroy houses, fences and cattle, and many human lives are lost. The cause is carelessness, almost always. People forget that wind and hot weather may make even the smallest fire spread beyond control. Thinking no harm will come of it, they leave the camp fires burning, throw away burning matches or tobacco, burn slashings or brush heaps without watching them closely, or run logging or railroad engines without screens to stop the sparks. At the time they see no danger. A few hours or days afterward the fire spreads and becomes so fierce it cannot be stopped.

People do not realize how much it will injure them. Sometimes they think only the owner of the timber has any interest in the matter, and that he ought to take all necessary steps to put the fires out. They forget that the owner stands only about a fifth of the loss and that four-fifths is borne by all the rest of the people in the state, including themselves, because everybody shares in the money and good that comes from the forests.

It is just as wrong to set fire to the woods as it would be to set fire to a house, and it is even more wrong, for we can build houses, but not new forests. When San Francisco was destroyed by fire, California did not have to bear all the loss. It was spread all over the world by insurance. Money quickly came in to rebuild the city, everyone was given work, and in two or three years business was going on as before. But when a forest burns, nothing helps us to recover. Its possibilities of good are destroyed forever. In order to protect our forests pass the best kind of forestry laws and allow plenty of money to carry them out. Fire patrol is particularly necessary.

It is the duty of everyone, young or old, not only to be careful with fire, but also to teach as many others as possible how important this matter is. Above all, everyone should remember that care with small fires will always prevent big ones. The main thing is never to forget the simple rules of preventing fires. Most of them are laws and anyone is liable to arrest for failing to observe them.

President Flewelling announced in an interview that twice as many men will be sent into northern Idaho forests the coming summer, beginning early in June, as were used for patrol work in 1910. Additional facilities will be provided and the railroad telegraph and telephone lines used in cases of emergency.

SPILLWAY, ORLAND PROJECT, CALIFORNIA.

THE ORLAND PROJECT ABOUT FINISHED.

By F. H. Griswold.

Orland, Cal., is becoming a center of considerable activity. The celebration of the turning on of water on the project, which is one of the most attractive among those undertaken by the reclamation service, is set for June 16 and 17, and is to be made the occasion for a celebration that will bring several thousand visitors. In addition, the problem of how to irrigate 60,000 to 70,000 more acres is being discussed at mass meetings. In case the government is unable

to do the work the land will be irrigated under the provisions of the Wright act. The original Orland project includes only 14,000 acres, but it is to be made the nucleus of one of the choicest irrigated areas in California. A similar spirit prevails throughout the entire Sacramento valley, where new projects are continually being started. Within two or three years the offerings of irrigated land in the northern part of California will be enormous.

Orland's celebration is to take the form of a varied program. There will be speeches by noted men; a parade with such novelties as a jerk-line mule team, cowboys, Indians, etc.; a night parade and carnival; an auto race to the dam at East Park and return, a total distance of 120 miles; broncho busting and running battle on the streets between cowboys and Indians; baseball tournament and athletic meet; amusement features and concessions in an area to be called the "spillway"; and a tented city for the accommodation of the guests. Special trains will be run from Sacramento and other points.

The first unit of the Orland project, consisting of 14,000 acres, is in operation. It is about eighty-five per cent complete, the unfinished portion consisting of a diversion dam and other features, the absence of which will not interfere with the irrigation of the land. The fact that the army engineers did not recommend an appropriation for Orland has been misunderstood in many quarters. The fact is that the appropriation was not given for the reason that it was not needed. What the people of Orland wanted was to enlarge the project by taking in a second unit of 25,000 acres and the engineers hesitated about this. There is plenty of water for the additional 25,000 acres, however, and all of the expensive work in that connection has been done, so it is likely that the proposed development will come.

The Orland project was intended originally to serve merely as an object lesson of what can be done in the Sacramento valley by irrigation, so as to encourage development by private capital. A proposition to install a power plant, similar to the ones built in Arizona and elsewhere under government direction, was turned down by the army engineers. But this had nothing to do with the operation of the project. As is the case with practically every other project undertaken by the reclamation service, the land at Orland is under private ownership.

Orland is destined to become the center of a new citrus belt, according to the views of those who are connected with the development of the project. And there are enough groves in existence today to prove that there is a strong basis for the claims. Oranges, lemons and grape fruit, or pomelos, grow in such number at Orland that the perfume of the blossoms is strong when one approaches the town in the spring.

The ground near the town is especially well adapted for fruit, although other farm products can be grown there is wide diversity. A large proportion of the land close to town has been planted to oranges and there are several thriving groves. Lemons and grape fruit, or pomelo, have been grown successfully, although not on as large a scale as oranges. All the deciduous fruits do well and conditions are well adapted to drying, or curing, prunes or apricots. The peach is another strong grower. The almond orchards are especially attractive. There is one of thirty-three acres that has netted $100 an acre for the last eight years. The man who owns it came to Orland in 1893 with less than $1,000. The almonds are of exceptional size and quality.

DAM AT EAST PARK, COLO., IMPOUNDING WATER OF STONY CREEK FOR USE ON THE ORLAND PROJECT.

There is considerable gravel in patches around Orland, but some of the fruit growers prefer such soil as trees thrive in it. Alfalfa and various other farm crops are grown in many places, but it is likely that this will be best known in the future for its fruit. The claim is made by the growers that they can market oranges several weeks ahead of southern California, as they have an inland instead of an ocean climate.

The country supplied with water from the government ditches is slowly filling up, but all of the land has not yet been brought under cultivation. The surroundings are especially attractive as the town lies within only a few miles of the foothills, which offer chances for hunting and fishing, in addition to many attractive trips. The town is as neat and spotless as any place one could wish to see. The streets are clean and the yards show an abundance of flowers. Many of the buildings are of concrete, the material having been taken from Stony Creek, which offers an abundant supply for construction.

ARID AGRICULTURE

BY

B. C. BUFFUM, M. S.

Manager of the Wyoming Plant and Seed Breeding Company, Worland. Former Professor of Agriculture in the University of Wyoming and the Colorado Agricultural College, and Director of the Wyoming Agricultural Experiment Station.

Raising Diversity of Crops Advisable.

Prof. B. C. Buffum.

Growing sugar beets adds a crop to those usually produced on a farm. It does not take the place of other crops, but adds a new one. Diversifying the crop does many things for the farmer. He uses his land and employs his labor to better advantage. If he has several crops and one fails he can better afford to stand the loss, as there are others which secure an income.

Sugar Both a Luxury and a Necessity.

There is usually more money made by producing luxuries than anything else. Sugar is both a concentrated food and one of our greatest luxuries. The people of England use one-third more sugar per capita than the people in the United States. A few years ago an estimate was made that it would require 700 additional factories to supply our demand, and that demand is continually increasing. It seems that there can be no possible danger of glutting the market.

Beets Will Grow on Alkali Land.

Finally, sugar beets fill a niche in our farming not filled by any other crop. They belong to a family of plants which rejoice in salty soils and will grow on our alkali lands. Farmers generally in irrigated regions know what it is to see portions of the farm becoming less productive through the rise of alkali to the surface. I know of no valuable crop, unless it is English rape, which will grow in as strong alkali as will the sugar beet. Nor does the common, white alkali of this region injure the beets in any way, except that these salts may retard or prevent the germination of the seed. If such land is to be planted to beets the surface should have the salts washed out so that they will not be in concentrated form around the seed. Flooding water over the land will wash off the surface salt or dilute it and carry it back into the soil. Then the application of a dressing of manure to mix with the surface soil will help the land, prevent the rapid rise of salt again and enable the seeds to properly germinate. After the plants become well established the salts will do no harm if the soil can be kept in a good state of tilth.

Sugar Beet Culture.

The land for sugar beets should be prepared in the fall. After the season's crop is removed, manure should be applied at the rate of ten to thirty loads per acre, the amount depending upon how green and strong it is. Manure from the sheep corrals is of the best for this purpose. We are not afraid of getting the ground too rich, but the danger lies in getting it too porous, thus allowing it to dry out quickly, especially in the early spring. The manure should be plowed under in the fall if possible, even if the ground is very dry.

Fertilizing—Plowing.

It is better to sharpen the plow share for each acre and get the land plowed deep, eight to twelve inches is best, but if the ground has previously been plowed five or six inches, not more than two inches of the under soil should be turned to the surface, because it is poor in vegetable matter and fertility, so the young beet will not get an early start and vigorous growth.

Irrigating Land.

After the ground is plowed and harrowed, it should, if possible, be irrigated in the fall. The moisture left in the ground from this irrigation will be sufficient to germinate the seed the following spring.

Harrowing Land.

The ground will be pulverized by the frost and when harrowed in the spring will be in the best condition for the reception of the seed. The ground should be leveled so it may be easily irrigated. The work done in getting the ground in the best possible condition is profitably spent. No amount of work afterwards will make up for the lack of care in this.

Rolling.

Some roll the ground before, and some after seeding. This is usually a detriment to the crop. The harrow marks should be left in the field. The soil is generally left loose on top and evaporation is prevented by this earth mulch. The spring winds will not gather up the sand and fine particles of earth and slide them along the surface of the ground, cutting off the young beets, as they do when the ground has been flooded or when it has been rolled. When the last harrowing is done, drive so the harrow runs crossways of the prevailing direction of the spring winds.

Use Clean Ground.

Before planting your seeds be sure that the ground is free from sticks and all trash; go around with a wagon and pick this trash off. It will catch in your cultivator and before you can stop you have lost several feet in a row of beets. The damage is done. You have lost money. Alfalfa roots are like leather on your horse hoes. They will not be cut in two, but drag out and destroy the young plants. If you use alfalfa ground for your beets, plow the alfalfa as shallow as possible and still get all the roots cut. Follow with the harrow, harrowing out all roots and cart them off the land. Replow the ground three or four inches deeper than the first plowing and prepare the same as other ground. Alfalfa ground, fresh from the sod, produces fine beets, rich in sugar.

Time to Plant.

Beets should be planted early. Plant as soon as danger of freezing weather is over. A frost will not injure the young beets, but a freeze so hard that the ground is frozen one-fourth inch or more deep will kill the beets. The beets should be out of the ground and as far along as any of the weeds when it is time for the cultivator to start. The early planted beet gets a good start and shades the ground before hot weather begins.

Seeding.

The seed should be sown with the regular sugar beet drills, in drills 18 to 20 inches apart, and 1 inch to 1½ inches in depth. Spacing the rows 16 inches and 24 inches apart in order to furrow and irrigate between the wider alternate rows is a convenience on level ground where it can be applied.

These drills sow four rows at once and have two small wheels following each shoe of the drill, one on either side, and about one inch from the center of the shoe. These firm the soil about the seed and tend to bring the moisture to it, insuring an early germination. The beet seed requires considerable moisture before it will start, and it should never lack for moisture from the time it begins growth until the crop is "laid by" in August. The seed should be sown at the rate of 20 pounds per acre. It is poor economy to try to save seed. This amount of seed will produce many more plants than are desired, but it insures plants over the entire length of the row which, when thinned, should result in a nearly perfect stand.

If a crust has formed over the ground from rain or irrigation, each seed which grows will help the others, and all working together will push hard enough to break the crust so that the plants may get through. The importance of a good thick stand of beets cannot be over-estimated. In this lies the profit. It costs no more to grow, and little more to harvest, a crop of 30 tons per acre than it does a crop of 10 tons. The one crop yields a profit of $60 to $70 per acre, the other but pays the rent of the land and cost of growing.

Irrigating Seed.

If the ground is dry when the beets are planted, don't wait long for a rain, but turn on the water. The beets will be coming up in ten days or two weeks. The soil is likely to bake if irrigated, but you can follow by another irrigation, or if the plants are up so the rows can be seen, start the cultivator and use the horse "hoes" and "duck feet," or the "spiders," running the hoes as close to the rows as possible.

Harrowing Beets.

Some practice harrowing to break the crust. This should never be done lengthwise of the row, for the harrow tooth getting in the row will drag out the beets for several feet. Harrowing is a bad practice; it injures the stand and kills beets in many places where it is desirable that they should grow. Don't harrow your beets, use the cultivator.

(To Be Continued.)

PROPOSED REORGANIZATION OF THE BIG LOST RIVER IRRIGATION COMPANY IN IDAHO.

Harrison B. Riley, president of the Chicago Title & Trust Company, recently left Chicago for Boise City, Idaho, where he will confer with the Idaho State Land Board regarding the board's policy in the problem of reorganizing the Big Lost River Irrigation Company. This company defaulted in its bond interest payments early this year, following difficulties which appeared last year.

Mr. Riley goes west in the capacity of chairman of the bondholders' committee. His mission is to effect a reorganization if possible, and it was said at his office that the reorganization no doubt would be brought about soon after his return to Chicago. This appears not unlikely inasmuch as several of the banks here have recently reported a substantial awakening of favorable interest in irrigation securities, resulting in the placing recently of several large issues.

SOME SEED GRAIN SUGGESTIONS.

Have you any choice seed grain for sale, or will you need seed?

If you have any good seed grain, you should send a sample to your state experiment station, stating how much you have and the price you want for it. Your name will be listed and sent to those who ask for good seed.

If you need good seed, the state experiment station will tell you where to get it and what it will cost.

If you produce your own seed grain, it is important to select it early out of the best part of the crop and take good care of it.

You should never fail to use a good fanning mill, selecting only the heaviest and plumpest kernels of good body for sowing, and avoid planting shriveled and dwarfed kernels. Wheat, oats, barley and rye seed may be best prepared by fanning mills, which separate by size and by weight, by means of screens and wind blast. A good fanning mill, properly used, will more than pay for itself in a single season.

If your seed appears to be mixed or falling off in yield, it will pay you to get pure bred seed of the best strain adapted to your soil and climate. If you have any doubt as to what varieties to plant, write the state experiment station and ask them which will do best in your soil and climate.

Are you testing your seed for germinating qualities? It is a simple matter, and the State Experiment Station will send you full directions for doing it at home.

Do not waste your time in sowing new varieties (except on a small tract as an experiment) unless your State Experiment Station recommends them. You cannot afford to take the chances. Let the Experiment Station do the testing of new varieties and learn the results from them.

Whenever smut appears, treat the seed grain with formalin solution. Get the formula and method from the State Experiment Station. The treatment is very simple and effective.

By attention to these rules, you can increase your crop from 4 to 10 bushels per acre, with very little extra expense. Additional attention to cultural methods and soil fertilization will add further to the profits.

A corporation, known as the Lund & Preston Reservoir Company was recently organized and articles of incorporation filed. The company is capitalized at $50,000. The seat of operations will be White Pine County, Nevada. The officers and directors are A. R. Whitehead, of Lund, president; Christian Jensen, of Ely, vice-president; Henry Behrmann, of Preston, secretary; Robert Ried, of Lund, treasurer; Edward D. Funk, of Preston; William A. Vance, of Lund, and Dan T. Nicholas, of Preston, directors.

THE PRIMER OF HYDRAULICS*

By FREDERICK A. SMITH, C. E.

Article VII. The Principles of Mechanical Forces.

1. *General Principles.*

Any cause which produces motion or changes motion is called a *force.* A force which acts for only one instance is called an impulsive force and produces uniform rectilinear motion; and a force acting constantly like the force of gravity is called an incessant force and produces accelerated or retarded motion. The principal features of mechanical laws are expressed by Newton as follows: "Every body continues in its state of rest or motion in a straight line unless acted upon by some external force."

"Every motion or change of motion is in the direction of the force acting and proportional thereto."

"To every action there is always an equal and opposite reaction."

Forces are represented by straight lines, the length of which indicates its magnitude, the direction of which gives the direction of the force by the arrowhead. Thus in Fig. 55 $A\,B$ represents a certain force acting upon the point A in the direction $A\,B$ and with a strength proportionate to the length $A\,B$. If another force $A\,C$ acts upon the point A in the direction $A\,C$ and with a strength proportionate to its length; thus if $A\,B$ is 3 Force Units and $A\,C$ is 4 Force Units then the relation of the forces is fixed.

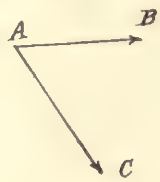


Fig. 55

Forces are usually measured by the pound which is the pressure exerted by the mass of a substance weighing a pound. Other units are used, such as the gram, or kilogram, but in the United States the pound as a weight unit and the foot as a lineal unit are still used almost exclusively.

2. *The Parallelogram of Forces.*

If two forces $A\,B$ and $A\,C$ act upon the point A under a certain angle then the point A cannot follow either of the two forces but will travel along a line AD which is the diagonal of a parallelogram formed about the two forces. The action of the two forces is then exactly the same as if a force AD alone was acting upon point A; such a force AD is called the resultant and AB and AC are called components and the arrangement is called the parallelogram of forces. This principle is used to find the resultant for any number of forces acting on the same point; when there are more than two forces it is called the polygon of forces.

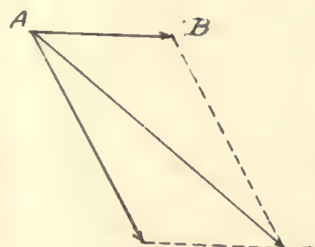


Fig. 56

One way of combining different forces acting on the same point A is shown in Fig. 57 where two rectangular axes AX and AY are drawn through the point A; given the forces P, Q, S and T and the angles α, β, γ and δ; by dropping perpendiculars from the ends of the forces to the X and Y axis each of the four given forces is decomposed into two forces acting rectangularly with each other; thus instead of P we have $P' = P \cos \alpha$ and $P'' = P \sin \alpha$; instead of Q we have $Q' = Q \sin \beta$ and $Q'' = Q \cos \beta$ instead of S where $S' = S \cos \gamma$ and $S'' = S$ sin

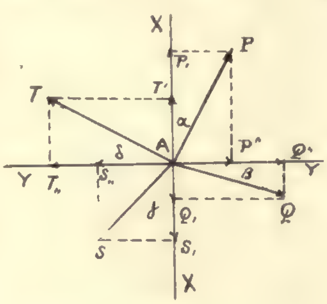


Fig. 57

*Copyright by D. H. Anderson

γ instead of T where $T' = T \sin \delta$ and $T'' = T \cos \delta$. So instead of the 4 original forces we have here 8 forces acting in rectangular axes; the four forces acting on the X X axis can be combined into one, namely, $P' + T' - Q' - S'$, which will give one force, this we will call R' acting upward; likewise the 4 forces on the Y Y axis can be reduced to one $= P'' + Q'' - S'' - T''$, which we will call R''; then the final combination is shown in Fig. 58, the two forces R' and R'' acting on point A under right angle; the resultant R is then the diagonal of the rectangle and $R = \sqrt{R_1^2 + R_{11}^2}$, also the directions of the Resultant is readily found, for, let angle $R_1 A R_{11} = n$, then $\operatorname{tg} n = \frac{R_1}{R_{11}}$

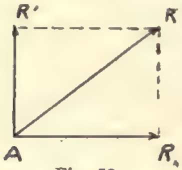


Fig. 58

3. *Parallel Forces Acting in the Same Direction.*

If two parallel forces P and Q tending in the same direction act upon a stiff bar A B, Fig. 59, then a resultant R may be set for P and Q, which is equal to the sum $P + Q$, also parallel to them and divides the distance A B inversely as P and Q, that means if R acts at the point C then $A\,C : B\,C = Q : P$. This is a very important principle; it is seen if the point C be supported so it could not move then the two forces P and Q will be in equilibrium; the product of the force P into its distance A C is called the moment of the force P, likewise the product of Q into the distance C B is the moment of the force Q with reference to point C. This principle can be extended to any number of parallel forces. The force of gravity acting on a body can be considered as a large number of parallel and equal forces, each acting upon a particle. Thus if in Fig. 60 A B is a line composed of a number of atoms A, B, C, D, E, F, G, H, then on each of them acts the force g downward, so for Ag and Bg we can set $Mg = Ag + Bg$, likewise for Cg and Dg we can set g_1 g_2 acting at M, also for Eg and Fg we can set g_2 g_3 acting at M and for Gg and Hg we can set g_3 g_4, so that instead of all the parallel forces we have but one force acting in the middle point M. This point is called the center of gravity; so if A B is a straight line or bar of uniform thickness its center of gravity is in its middle M, and if this point is supported then the whole bar will be in equilibrio, *i. e.*, will not move under the influence of gravity. It really acts as though the whole mass of the bar was concentrated in the center of gravity.

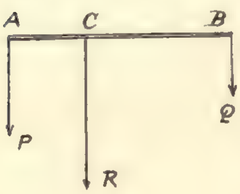


Fig. 59

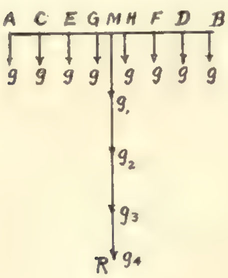


Fig. 60

4. *Center of Gravity for Various Shapes and Figures.*

The center of gravity of a line is in its middle.

The center of gravity of any symmetrical figure is in its geometrical center. Thus the centers of gravity of a parallelogram, rectangle rhombus and square are in the intersection point of the diagonals.

The center of gravity of a circle and the circle circumference is in the center of the circle.

The center of gravity of an ellipse lies midway between the two foci.

The center of gravity of a cylinder or right prism lies in the middle of its axis.

The center of gravity of a homogenous sphere lies in its center.

The center of gravity of a triangle lies in the intersection of its medians, *i. e.*, lines drawn from the corners to the middle points of the opposite sides; thus if in Fig. 61 the lines AM, BO and CN are medians intersecting in point P, then P is the center of gravity of the triangle and is located ⅓ of the length of the median from the base.

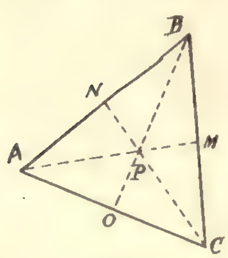


Fig. 61

Every body or shape has its center of gravity, and when it cannot be readily calculated it can be found experimentally as follows: Suspend the figures (see Fig. 62) by one corner A by sticking a pin through and having a thread A P with a little weight P attached, let the figure freely swing about the point A, and when at rest draw a light pencil line along A P over the figure, then the center of gravity must lie somewhere in this line A P.

Next hang up the figure from some other corner B and obtain another line B P, which intersects the line A P in O; then O is the required center of gravity.

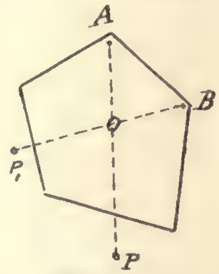


Fig. 62

The center of gravity of an arc of a circle is found as follows: let the length of arc A $B = a$ and the radius C $M = r$ and the length of chord A $B = c$, and let g be the distance of the center of gravity, G from C then $g = \frac{cr}{a}$ or in words: multiply the radius with the chord and divide by the length of the arc.

The center of gravity of every symmetrical body lies in its axis; thus the center of gravity of a sphere lies in its center, of a cylinder or regular prism in the middle of its axis, of a cone or regular pyramid upon the height ¼ of the distance from the base.

The center of gravity of the following circular figures lies on the axis of symmetry in each case; in the sector $2\,cr \div 3\,l$ from the center, of a semicircle .424 r from the center, of a quadrant .6 r and a segment $c^3 \div 12\,a$ from the center, r being length of a radius, c length of chord, l, center of arc and a = area of segment.

5. *The Laws of Gravity.*

The force of gravity when acting upon a free falling body produces an acceleration of 32.16 ft. per second, but the distance that a body falls the first second is 16.08 ft. This principle is illustrated in Fig. 63 in which the horizontal line indicates the time in seconds, and the ordinates v_1, v_2, v_3 and v_4 the velocities reached at the ends of the respective seconds, thus $v_1 = 32.16$ $v_2 = 64.32$, $v_3 = 96.48$, $v_4 = 128.64$, etc., the areas of the triangles represent the spaces fallen through; thus triangle 01A has an area of $\frac{1 \times 32.16}{2} = 16.08$, hence a body falls 16.08 ft. during the first second; the space fallen through in 2 seconds is represented by triangle 02B $= \frac{2 \times 64.32}{2} = 64.32$ ft.; the space fallen through in 3 seconds is represented by the area of triangle 03C $= \frac{3 \times 96.48}{2} = 144.72$ ft.; the space fallen through in 4 seconds is represented by the area of triangle 04D $= \frac{4 \times 128.64}{2} = 257.28$ ft. From these considerations the general law may be derived; if g is set for 32.16, then $v_2 = 2g$, $v_3 = 3g$, $v_4 = 4g$., etc., thus the velocity at the end of t seconds will be tg; now to determine the total space fallen through; the base of the triangle represents the time t and the height represents the velocity tg hence the area $= \frac{t^2 g}{2}$, so if h = space fallen through in t seconds $h = \frac{t^2 g}{2}$ and if V = velocity at the end of the time t then V

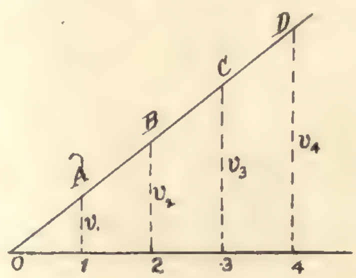


Fig. 63

$= tg = \frac{2h}{t}$, also $t^2 = \frac{2h}{g}$ or $t = \sqrt{\frac{2h}{g}}$, hence $v = g \sqrt{\frac{2h}{g}} = \sqrt{2gh}.$

These simple relations are very important as the force of gravity has to be dealt with everywhere, especially in hydraulic problems.

6. *Applied Problems.*

1. What is the velocity of a falling body at the end of the 7th second?

Answer: $7 \times 32.16 = 225.12$ ft.

2. What is the distance the body has fallen through in 7 seconds?

Answer: $h = \frac{t^2 g}{2} = \frac{7 \times 7 \times 3216}{2} = 49 \times 16.08 = 787.92$ ft.

3. How long will it take a body to fall 50 ft.?

$$t = \sqrt{\frac{2h}{g}} = \sqrt{\frac{2x50}{3216}} = \sqrt{3.1094} = 1.763 \text{ seconds.}$$

4. What is the velocity of a body after having fallen a distance of 50 ft.?

$V = \sqrt{2gh} = \sqrt{2 \times 32.16 \times 50} = \sqrt{32.16} = 56.701$ ft.

This checks the answer under 3, for if we multiply 1.763 by 32.16 we get 56.70 ft.

5. Through what distance must a body fall to acquire a velocity of 4 ft. per second?

For the solution of this problem use the formula:

$v = \sqrt{2gh}$ in which $g = 32.16$ and $h =$ the required height; square both sides of the equation:

$v^2 = 2gh$

Divide both sides by $2g$:

$v^2/2g = h$

Substitute the given quantities:

$4 \times 4 \div 2 \times 32.16$; for ordinary problems it is near enough to use 32 instead of 32.16; hence:

$h = 16 \div 64 = \frac{1}{4} = 3$ inches.

This shows that after a body has fallen 3 inches it has acquired a velocity of 4 ft per second.

Summary of Formulæ is herewith given, referring to them in future by the letter given.

Let in all the formulae the following terms be used:

$g =$ acceleration of gravity $= 32.16$ ft. per sec.

$t =$ no. of seconds.

$v =$ velocity in ft. per second.

$h =$ height of fall in ft.; also termed the head when flowing water is considered, then

Formula $A : v = tg$

" $B : h = t^2g/2$

" $C : v = \sqrt{2gh}$

" $D : h = v^2 \div 2g$

These formulae establish the relation between velocity, time and height of fall.

Article VIII. The Three States of Matter.

1. *General Principles.*

All things in Nature are either solids, fluids or vapors (gases), and some substances, like water, are known in all three states, namely in the solid form as ice and snow, as a fluid under normal conditions, and in the form of steam when heated to a certain point.

The state of a solid can then be defined that in a solid the molecules lie very near to each other so that is requires force to separate them; this proves the existence of an attractive force between the molecules, tending to pull the particles together; this force is called *cohesion.* It is assumed that there is also a repellant force active between the molecules tending to separate them; this force is called *repulsion.* Under the influence of these two forces the molecules are in a constant state of vibration; when a contraction of a substance takes place, due either to pressure or cold, then the cohesion increases, pulling the particles together; if heat is applied to a body the repulsion is increased and causes the expansion of the body. This expansion may become so great that the repulsion balances the cohesion and then the state of solid is changed to that of a fluid; in this state the body offers little resistance to the separation of its particles. If heat is continued to be applied the repulsion grows and overbalances the cohesion; then the state of the fluid changes to that of a gas, in which state the molecules tend to separate indefinitely and force must be applied to keep them together; thus, if sulphurated hydrogen is, for instance, set free by letting sulphuric acid act on iron sulphide, the gas will permeate at once the whole room, which is proved that it can be smelled all over the room.

Generally speaking, all substances can be transformed into the three states of matter by the agencies of heat or pressure, or both. Thus gold may be melted and even vaporized by using sufficiently high temperature; also oxygen gas may be made fluid by applying high pressure and cold, and may even be made solid by applying intense cold and very high pressure. The terms solids, fluids and gases apply to bodies that under ordinary conditions are solid, fluid or gaseous.

2. *Special Properties of Solids.*

a. Hardness. All solids offer a certain resistance to being broken. The Mohr's Scale of Hardness is used to designate the different degrees of hardness, namely: (1) Talc, (2) Selemite, (3) Calcite, (4) Fluorite, (5) Apatite, (6) Adularia, (7) Quartz, (8) Topaz, (9) Sapphire, and (10) Diamond. To test any substance for its hardness try to scratch with it the above named substances in succession; if it scratches, for instance, calcite but does not scratch fluorite its hardness is between 3 and 4 of Mohr"s Scale.

b. Malleability is the property of being widened out under the hammer, like lead or gold.

Ductility is the property of some substances to be drawn out in wires. The most ductile substance is platinum, which has been drawn into wires so fine that its diameter equals .00003 inch.

c. Tenacity is called the resistance different substances offer to being broken or ruptured. It is measured by the tensile strength of structural or building materials.

d. Elasticity is the tendency of bodies to assume their original form after having undergone a distortion; this property is also called *rigidity* when the body offers resistance only to distortion.

Forces which tend to produce alterations or distortions in bodies are called stresses; they are shearing, twisting and bending stresses. The bending stresses may be either compressive or tensile according to whether the forces tend to compress or elongate the fibres of the body under stress.

3. *Properties of Fluids.*

a. The surface of fluids at rest is horizontal. There being no rigidity between the molecules of a fluid their shape is altered by the least force so that when a fluid is at rest its surface is horizontal and it fills the form of the containing vessel. That the surface of a liquid must be at right angles to the force of gravity is seen from the following deduction; referring to Fig. 64, let BC be the surface of a fluid not at rest and let A be a particle of the fluid; the force of gravity AG pulls on A in a vertical direction and AG may be decomposed into AG_I, acting normally to the surface of the fluid, and AG_{II}, acting in a horizontal direction; the force AG_I is neutralized by the body of the fluid but the force AG_{II} will pull point A down toward C and this will be kept up with all particles until the surface BC is normal to AG, or with other words until the surface of the fluid is level.

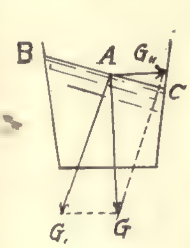


Fig. 64

b. The pressure in fluids is transmitted equally in all directions.

Fluids transmit pressure equally in all directions. An application of this principle is shown in Fig. 65, which represents a hydrostatic press, consisting of 2 cylinders c and C in which pistons p and P can move up and down; a valve v_1 admits water to cylinder c and valve v admits water to cylinder C so that if piston

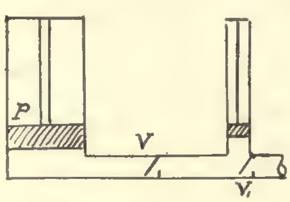


Fig. 65

p moves up valve v_1 opens and admits water; when p is forced down v_1 closes and v opens and the pressure which p exerts against the water surface is transmitted undiminished in all directions thus to the lower surface of the piston P, which rises and lifts the superimposed load. If the area of piston p is one square inch and the pressure forcing it down is 10 lbs., then the pressure exerted on the fluid is 10 lbs. per square; if the area of the piston P is 400 square inches then the total upward pressure on it will be 400×10 lbs. $= 4{,}000$; thus a force of 10 lbs. on piston p would hold a load of 4,000 lbs. on piston P in equilibrio, and a small excess of the force on p will make the piston P rise with its load. It is seen, however, that while a small force of 10 lbs. is lifting a load of 4,000 lbs. that the piston p has to work through 400 inches while piston P rises only 1 inch; so what is gained in power is lost in time.

c. The pressure depends on depth and area of surface. In a vessel filled with a fluid at rest the pressure due to the weight of the fluid must be considered. Thus the pressure on the bottom of a vessel is equal to the weight of the liquid resting thereon. In Fig. 66 are shown 3 vessels, A, B and C, filled to the same height with a liquid; then the pressure per square inch on the bottom of A, B and C is equal per square inch. But if the area of bottom in vessel A is 2 square inches, in B 8 square inches and in C 1 square inch, then the pressure on the bottom of A is twice and in B is 8 times as great as in C, regardless of the amount of water in the various vessels. Also if the surface of the walls of a vessel is considered, the pressure as against the areas a, b and c is equal to the weight of a column of water having a base equal to the areas a, b and c respectively, and having a height reaching from the center of gravity of the section to the surface of the water.

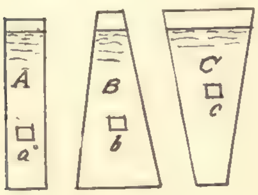


Fig. 66

Wilhelm K. Winterhalter, already widely known in California and western states, has recently opened a consulting agricultural office at Los Angeles. He will supply expert advice on irrigation propositions to prospective investors or bonding companies.

The Canadian Pacific announces that J. S. Dennis, assistant to William Whyte, vice-president, has been made manager of the company's irrigation and land interests in the provinces of Alberta and British Columbia. His headquarters will remain at Calgary.

An English engineer has been employed by the Turkish government to investigate the possibility of restoring the ancient canals of Mesopotamia in the hope that that now barren land may regain its ancient luxuriance.

The Agricultural Improvement Association of New York State, with principal offices in New York City, has been incorporated to deal in property, irrigated lands and develop water power. Directors are: President, W. C. Brown, of the New York Central Railroad Company; William McCarroll, E. Pfarrius and Welden Ring, New York; Congressman John W. Dwight, Dryden; George A. Frisbie, Utica; Ralph Peters, Long Island City; William C. Barry and E. G. Miner, Rochester.

A. E. Robinson, formerly First Assistant Engineer for the Federal Mining and Smelting Company at Wallace, is reported to be slated for the office of State Engineer of Idaho. Governor-elect Hawley is said to have given assurances of his appointment.

At a recent meeting of the People's Irrigation District, embracing land in the vicinity of Payette, the final records were made on the cost of construction of the irrigation system, which is now complete. The cost was $4,196.05, all of which has been paid.

Supreme Court Decisions

Irrigation Cases

LANDLORD AND TENANT.

In an action by a landlord to recover one-half of a rice crop raised by defendant as plaintiff's tenant, defendant, by a plea in reconvention, claimed damages for plaintiff's failure to construct an irrigation lateral to his rice land, and plaintiff in a supplemental petition alleged that, after the water was turned in, defendant could easily have made it sufficient, and was not entitled to damages, and defendant answered by general denial, and alleging that after the water was turned in plaintiff prevented him from fixing it, and caused men to dig barrow pits or ditches on the inside of such lateral, which became so boggy that defendant could not use his teams inside the levee, and that he could not take dirt from the outside to build it higher, as the land belonged to third parties, defendant, to excuse his alleged negligence could show that there were barrow pits outside the levee rendering the taking of earth impossible, for the general denial placed the burden of proving his negligence on plaintiff, and anything which would rebut that was admissible. *Poultra* v. *Martin.* Court of Civil Appeals of Texas. 135 Southwestern 725.

ADJUDICATION OF WATER RIGHTS.

A decree adjudicating water rights gave each of certain ditches a priority number, and an amount of water equal to the carrying capacity of the ditch, followed by a proviso limiting the amount of water permitted to flow into a ditch to a designated number of cubic feet per second "until such time as said parties shall have increased their cultivated meadow and pasture thereunder land to more than (naming the exact acreage then in cultivation) and then the increase in the amount of water so permitted to flow into said ditch shall only be in the ration and proportion of one cubic foot per second for each 40 acres of such additional lands. And provided, further, that said increase of such additional lands and the user thereon of such proportionate additional amount of water appropriated therefor shall be made with due diligence." *Held,* that the decree was absolute as to that portion decreeing that there should be permitted to flow into the respective ditches the amount of water that had at that time been applied to a beneficial use and interlocutory as to the remainder of the carrying capacity of such ditches, and that whatever rights were covered by the interlocutory portions were inchoate. *Crawford Clipper Ditch Co.* v. *Needle Rock Ditch Co.* Supreme Court of Colorado. 114 Pacific 655.

AMOUNT OF APPROPRIATION.

An allowance of one inch of water to an acre for irrigation in adjusting priorities will not be increased to allow for seepage and evaporation; that amount being intended to include such loss. *Nevada Ditch Co.* v. *Canyon & Sand Hollow Ditch Co.* Supreme Court of Oregon. 114 Pacific 86.

APPROPRIATION.

In this territory a corporation has the right to make an appropriation of water from a natural stream and distribute it to those who may require it for purposes of irrigation, whether it has land connected with such irrigation system or not. *Hagerman Irrigation Co.* v. *McMurry.* Supreme Court of New Mexico. 113 Pacific 823.

NO MONOPOLY FOR PROMISCUOUS SALE.

The right to the beneficial use of water to be acquired under the permit applied for under Act Feb. 24, 1909, known as the "Water Code" (Laws 1909, p. 332) § 45 et seq., is not an opportunity to acquire a monopoly of the water of a stream for promiscuous sale, but must contemplate a use on specific land which, when completed under section 53, shall become appurtenant to the land to which it is applied. *Cookinham* v. *Lewis.* Supreme Court of Oregon. 114 Pacific 88.

IRRIGATION BONDS.

Bonds issued by an irrigation district after a decree confirming its proceedings in the issuance of bonds may be held valid in the hands of bona fide holders and enforceable by levy of assessments to pay interest after a later judgment declaring the issuance of bonds to have been void. *Haese*

v. *Heitzeg.* Supreme Court of California. 114 Pacific 816.

ADVERSE USE.

The use of water by a subsequent appropriator does not begin to be "adverse'," as against a prior appropriator, unless it results in a deprivation to such appropriator, or amounts to such an invasion of his rights as will enable him at any time during the statutory period to maintain an action against the subsequent appropriator. *Featherman* v. *Hennessey.* Supreme Court of Montana. 113 Pacific 751.

JURISDICTION OF STATE ENGINEER.

A project to irrigate lands in New Mexico from the water of a natural stream running from Colorado into New Mexico, when the point of diversion, the head gate, and about six miles of the irrigation ditch are in Colorado, is not within the jurisdiction of the territorial engineer of New Mexico, and he is without authority to issue a permit for such a project. *Turley* v. *Furman.* Supreme Court of New Mexico. 114 Pacific 278.

LEASE OF WATER PRIVILEGE.

The owner of semiarid land, by executing a contract of lease therefor and granting the right to use an appurtenant water privilege, impliedly covenants that he will do nothing to interfere with the tenant's quiet enjoyment of the real estate or of the water privilege during the term. *North Platte Land & Water Co.* v. *Arnett.* Supreme Court of Nebraska. 130 Northwestern 752.

PERMIT OF USER.

Defendant by agreeing at plaintiff's request that he and his wife surrender all their rights as riparian owners in a creek except those exercised by a certain ditch to get his wife, in whose name the property stood, to waive such rights did not amount to an acknowledgment of plaintiff's right to prevent the diversion of water through such ditch so as to prevent defendant from claiming a prescriptive right to maintain the ditch. *Logan* v. *Guichard.* Supreme Court of Califonia. 114 Pacific 989.

BREACH OF CONTRACT.

Where one leased land from an irrigation company, the contract especially providing that each party should be the owner in fee simple of one-half of the crop, and that the company should furnish irrigation water for the crop, the lessee by dividing the crop and giving the lessor one-half was not estopped from claiming damages from the lessor for breach of the contract to furnish water; no such intent appearing from the contract. *Beaumont Irrigating Company* v. *Gregory.* Court of Civil Appeals of Texas. 136 Southwestern 545.

CHANGE IN METHOD OF APPROPRIATION.

Where the withdrawal of upappropriated water from a lake by subsequent appropriators required a change of methods or means by which prior appropriators were enabled to withdraw their water from a lake, and this entailed additional expense, such additional expense should be borne by the subsequent appropriators as a condition to their right to appropriate the unappropriated water. *Salt Lake City* v. *Gardner.* Supreme Court of Utah. 114 Pacific 147.

COMPENSATION.

It was the intention of the framers of the Constitution, by the provisions of this section, to provide that waters previously appropriated for manufacturing purposes may be taken and appropriated for domestic use, upon due and fair compensation therefor; but it was not the intention to provide that water appropriated for manufacturing purposes could thereafter arbitrarily and without compensation be appropriated for domestic purposes. *Montpelier Milling Co.* v. *City of Montpelier.* Supreme Court of Idaho. 113 Pacific 471.

DITCH AGREEMENT.

Defendant agreed with plaintiff that plaintiff might make a ditch across defendant's land to convey water for plaintiff's crops, defendant to have the right to carry his own water in the ditch, and to use plaintiff's water only when not required by plaintiff. *Held,* in an action for depriving plaintiff's crops of the necessary water, that it was no defense that plaintiff did not have a valid appropriation of the water claimed by him, so long as it was not defendant's. *Dalton* v. *Kelsey.* Supreme Court of Oregon. 114 Pacific 464.

PRIORITY OF OWNERSHIP.

Riparian owners who located on claims in 1876, and were residing thereon on February 28, 1877, when the lands were opened to public settlement, and continued to reside thereon until after patents were issued to them, had a claim to the water rights prior to the water rights located in 1878 by another, the patents relating back to the date of the settlement, so that a provision in the patents that they were subject to vested and accrued water rights did not apply. *Redwater Land & Canal Co.* v. *Jones.* Supreme Court of South Dakota. 130 Northwestern 85.

INTERMITTENT FLOW.

Under an irrigation contract providing that the time and manner of delivering and regulating the supply might be prescribed by the water company by regulations made from time to time, and that it might shut off water whenever it deemed it necessary for repairs, a regulation providing for an intermittent flow by dividing the consumers into two groups, and delivering water to one group for three days, and to the other for three days, could not be said as a matter of law to be unreasonable, unless the amount of water agreed upon was not furnished, in view of the rule that water contracts are mutual and will be construed in the light of the necessities of the parties, in case of dispute as to the amount. *Shafford* v. *White Bluffs Land & Irrigation Co.* Supreme Court of Washington. 114 Pacific 883.

IRRIGATION RIGHTS—

Where, in a contest over rights of water for irrigation purposes, the court found that a hundred inches of water was necessary for the proper irrigation of J.'s riparian lands, it was not essential that the amount of water in the stream or the number of persons holding riparian rights should be proved, to define the amount of J.'s reasonable use, as against plaintiff, whose only right to the water as against J. was to prevent him from wasting it. *Lone Tree Ditch Co.* v. *Cyclone Ditch Co.* Supreme Court of South Dakota. 128 Northwestern 596.

INJUNCTION AGAINST DIVERSION—

Under Rev. St. 1895, art. 2989, as amended by Laws 31st Leg. c. 34, providing for the grant of a writ of injunction where it shall appear that the party applying for the writ is entitled to the relief demanded, and such relief or any part thereof requires the restraint of some act prejudicial to the applicant, and Rev. St. 1895, art. 3115 et seq., declaring that unappropriated waters of flowing rivers may be acquired for irrigation and other purposes, a lower riparian owner is not entitled to a temporary injunction against the diversion of water for the irrigation of nonriparian land in the absence of a showing that his land is now being used or is intended for immediate use or is prepared for agricultural or other purposes rendering the use of the water of the river necessary and beneficial. *Biggs* v. *Leffingwell.* Court of Civil Appeals of Texas. 132 Southwestern 902.

OBSTRUCTION OF IRRIGATION DITCH—

Where the complaint, in an action to quiet title to an irrigation ditch, and to enjoin interference therewith, and for damages for a wrongful interference, showed that the object of the suit was to prevent defendant from inflicting on plaintiff, irreparable injury, and to obtain compensation for damages already individually suffered by him from the acts of defendant, allegations of the complaint that plaintiff had conveyed to third person tracts of land with a distinct agreement that the tracts were entitled to receive the benefits of irrigation by means of the ditch, and that defendant's obstruction of the ditch would subject plaintiff to litigation, did not require that the third persons be made parties, since such allegations merely disclosed the extent of the injury to plaintiff through the conduct of defendant, and plaintiff could obtain equitable relief and compensation for the damages suffered by him. *Sisk* v. *Caswell.* Court of Appeal, Third District, California. 112 Pacific 185.

The Milford Improvement Company of Salt Lake has filed articles of incorporation, showing a capital stock of $10,000. They will carry on a construction, irrigation and general farm business.

CORRESPONDENCE

Seattle, Wash., May 17, 1911.

IRRIGATION AGE,
Chicago, Ill.

Dear Editor: We would like to know the United States government standard of water on irrigated projects pertaining to the state of Washington, and also what one (1) cubic foot of water per second of time for one hundred and sixty acres of land figures in gallons per acre. We would like to have you figure this out and publish the answer in your next issue, if possible.

Yours very truly,

BANGHAM & FLETCHER.

Regarding the first question as to the United States government standard of water on irrigated projects in the state of Washington, the Editor requests some more definite specification, as he don't quite get at the meaning.

As to the second query, what one cubic ft. of water per second figures in gallons per acre for 160 acres of land: One cubic ft. of water is about 7.5 gallons, so that if a flow of 1 cubic ft. per second is maintained for 160 seconds it will deliver 7½ gallons per acre. Hence the time of flow is a very important element; it should be remembered, for instance, that if a stream of one cubic ft. per second was flowing for say 100 hours steady, it would deliver 100 × 60 × 60 = 360,000 cubic ft. of water; if this is divided by 160 gives 2,250 cubic ft. per acre, which, multiplied by 7½, gives 16,875 gallons per acre; since 1 acre contains 43,560 square feet the depth of this water all over an acre can be found as follows: First multiply 2,250 by 12, which gives 27,000; then divide this by 43,560, which gives a depth of .62 inches or about ⅝".—Editor.

WANTS INFORMATION.

Scobey, Mont., May 21.

IRRIGATION AGE:

I would like suggestions in your question department regarding desert claim to be proved up by means of dam and springs. What is best method of putting in dam when there is a gravel subsoil? Also any other method of irrigating several hundred acres, not too expensive?

Yours respectfully,

HAROLD CLARK.

There is hardly enough information in this letter on which to base any specific advice. The conditions indicated would suggest springs as a source of water supply and possibility of forming a small reservoir which, by raising the water level, can be made available to irrigate some land at a lower level. In the April issue of THE IRRIGATION AGE is a good description and many good suggestions how to build a satisfactory dam on land of gravel subsoil. The point especially to be watched is that the sheeting is driven deep enough to prevent the seepage water from rising under the dam and cutting away the soil from under its foundation. See article on page 856 in the April issue of THE IRRIGATION AGE for more definite information.—Editor.

FLOW OF ONE-EIGHTH CUBIC FEET PER SECOND.

Stamford, Texas, May 23, 1911.

IRRIGATION AGE:

Please answer through your correspondence department. I have a contract for 53.34 shares of the capital stock of an irrigation company selling land under the Carey Act in Idaho. Each share entitles me to ⅛ of a cubic foot of water per second of time per acre. Is this ample water for irrigation where there is no rain, for all crops? Exactly how much water is this? Under the Carey Act in Idaho what recourse would I have should the contracted amount of water not be supplied? Yours truly,

E. L. MATTOON.

A flow of water of ⅛ of a cubic ft. per second per acre means a little less than a gallon (1 cubic ft. = 7.48 gallons); on this basis it means 60 gallons per minute and 3,600 gallons per hour and 86,400 gallons per day of 24 hours; if this is multiplied by 365 days it means 31,560,000 gallons per annum. Divide by 8 gives 3,942,000 cubic ft. of water, and as an acre contains 43,560 square feet, by dividing 43,560 into 3,942,000 gives a depth of 90½ ft. of water per acre per year, equivalent to a rainfall of 1,086 inches per annum. This is an enormous amount of water and would be entirely too much, only for the fact that the water is turned on only occasionally when wanted. Thus if the flow occurs only 1 day per month on an average it will amount to a depth of 36.2 inches over the area of the acre.

A SATISFACTORY AND INSTRUCTIVE EXPLANATION.

Phoenix, Arizona, May 23, 1911.

Editor of the IRRIGATION AGE:

I have read with much interest your article in the May number of your magazine on the Roosevelt dam in the Salt river project. There are one or two inconsistencies in the first part of the article, which is otherwise very accurate, and a moment's consideration of the proofreader would have shown the error.

On the fifth line from the bottom you state that the reservoir covers an area of 16,300 acres, etc.; that it is over 200 feet deep at the dam but the average depth does not exceed 16 feet, and when the reservoir is full it contains 1,284,200 acre feet of water. The average depth is, therefore, about eighty feet. Later on in the article you call attention to the fact that water is leaking through the rocks around the dam. Quite a considerable leakage does exist through the rocks around the dam, but unfortunately your correspondent was not aware, perhaps, of the fact that that this water is warm—in fact, quite warm. Under the reservoir, a mile or two above the dam, there existed some large hot springs which, since the reservoir has filled partially with water, have been forced to take another path and follow the crevices in the rocks issuing along the walls of the canyon for about a quarter of a mile below the dam. All the water is warmer considerably than the water in the reservoir, and much of it is so hot immediately where it issues from the rock as to be unbearable to the hand. The rocks forming the side wall of the canyon, dip upstream at an angle of about twenty-five degrees so that, if the water follows the seams in the rock, it must pass under the dam at a depth of from 300 to 500 feet below the bottom of the dam. The sidewalls of the canyon, through the crevices of which small streams of hot water are issuing, are quartzite, and during the time in which there has been water in the reservoir (over two years now), there has been no increase in the flow and on one side of the canyon a very material decrease.

Very truly yours,

LOUIS C. HILL.
Supervising Engineer.

We are glad to thus hear directly from Mr. Hill, Supervising Engineer, giving such satisfactory and instructive facts in relation to the Roosevelt dam, and our readers will, no doubt, appreciate the same.—Editor.

THANKS, MR. COLLINS.

San Antonio, May 19, 1911.

D. H. Anderson:

You will please find enclosed two dollars. Please move me up two years. I have taken your paper since its first year and it is well worth many times its price. I have been interested in irrigation in Texas since 1872 and have now, I think, the best 170 acre farm in the United States. Can sell for $1,500 an acre. How is that for an irrigated farm in Texas, where all plants have thorns and frogs have horns? Truly yours,

F. F. COLLINS.

FARMERS' INSTITUTE WORKERS' ANNUAL MEETING.

May 24, 1911.

Editor Irrigation Age:

The next annual meeting of the American Association of Farmers' Institute Workers will be held at Columbus, Ohio, November 13 to 15, 1911. At the same place and beginning November 15, will be held the annual meeting of the Association of American Agricultural Colleges and Experiment Stations.

Notice is sent out thus early in order that farmers'

institute workers in arranging their work may have in mind the date of this meeting, and so arrange that it may be possible for all who are interested to attend.

Very truly yours,
JOHN HAMILTON,
Farmers' Institute Specialist.

ELECTRIC IRRIGATION BY THE NORTHERN COLORADO POWER COMPANY.

THE pumping of underflow and seepage water from wells for irrigation purposes throughout the northern part of the state of Colorado and southern Wyoming has been carried on with increasing popularity during the past eighteen months.

The Northern Colorado Power Company has a large steam power plant of 15,000 horse power capacity located in the center of the northern coal fields, twenty miles from Denver, from which several hundred miles of transmission and distribution lines are carried throughout a splendid agricultural country.

The pumping is very largely done by individual farmers who have installed motor driven centrifugal pumps operated by electric motors, which supply water from wells, averaging in depth from fifteen to twenty-five feet, and for tracts of land varying from eighty to six hundred and forty acres from a single well.

There is a pronounced underflow underlying the entire northern part of the state, east of the mountains, stretching out from the foot hills towards the plains, and twenty feet is the average depth at which water is found in dependable quantities.

The first years efforts to secure the adoption of electric drive for irrigation work was purely a matter of education, as the average farmer looked upon the use of electric current as something suitable for the manufacturing industries in the city, for the lighting of city homes, and for general uses in the city, but had not considered its use in the light of a possible advantage for use upon the farm.

Practically one hundred plants are now in operation on the Northern Company's lines, irrigating about sixteen thousand acres of land, most of which lying above the ditch was formerly considered of very small value as agricultural lands and was purchased at prices ranging about twenty dollars per acre, but by the installation of the pumping plants has been increased in value to two hundred dollars to two hundred and fifty dollars per acre.

The farmers making use of motor driven pumps are very enthusiastic regarding the results which they receive and next to the low cost which they experience in carrying on the irrigation work by this means the tremendous advantage which they claim to be secured by being able to irrigate on the very days and hours which they deem best, and with just the proper amount of water, is of the greatest value to them.

Other than pumping from wells, use is made of pumping water from ditches, streams and reservoirs to lands above the ditch and many land owners who control water rights have found it advantageous to dispose of their ditch right to other parties and pump the underflow at a profit to themselves.

A considerable number of plants have been installed where pumping has been done from marsh or swamp lands. Here the work has been found to be doubly advantageous by draining the lowlands and reclaiming the swamps, which were of no value previously, and by raising the water to the table lands above, effecting a double service by one pumping.

On the system used by the Northern Colorado Power Company the electric current leaves the power house at a pressure of 44,000 volts and is carried to the numerous sub-stations located in the towns throughout the territory, where it is stepped down to 2,300 or 6,600 volts for local distribution.

The power company supplies the commercial and municipal demands in some twenty cities and towns and carries on its poles connecting the several towns low voltage wires, from which extensions can be made at any point to connect up the individual farmer's plants.

Usually 2,300-volt motors are installed and these average about twenty horse power each.

Current for this work is sold on the basis of a "fixed charge" of one dollar per horse power per month, for the irrigation months of May to September inclusive, plus a charge of three cents per kilowatt hour for the current consumed as measured by an electric meter.

Under the conditions the cost to the farmer for electric service and for interest and depreciation on his pumping plant will amount to from $1.00 to $2.00 per acre foot when water is being raised through a 25-foot lift, the variation depending upon the load factor under which the pumping is carried on, together with local conditions, such as efficiency of apparatus used and the type of equipment installed.

During the past two years it has been found that one acre foot of water is an average of the amount which had to be pumped in excess of rainfall for the average crops raised in the territory supplied.

As soon as the farmers installed the motor driven pumps for irrigation purposes they began to find all kinds of use for the electric power upon the farm and farmers in northern Colorado generally use the electric current for house and barn lighting, feed chopping, for stock feeding—which has been increased tremendously during the past year—for the operation of milk separators and for driving the suction milking machine, for running the small repair shop upon the farm, for shearing sheep and for operating the threshing machine at harvest time.

Experiments are about to be made in adopting the German method of plowing some of the large farms, by means of the motor driven drums and cables on gang plows, which it is believed can be successfully and economically done.

The pronounced success secured in the furnishing of electric energy for the purposes enumerated, has demonstrated to both the consumer and the power company the value of this class of business, and has encouraged the building of lines to cover the tremendously increased territory so that the territory of Northern Colorado will be practically cobwebbed with electric feeder lines when the work now under way is brought to a final completion.

Grazing Examiners for National Forests

A new Government position is disclosed by the announcement by the U. S. Civil Service Commission of an examination which will be held February 23 and 24 to find three grazing examiners for the Forest Service. The positions will pay a salary of $1,200 a year at entrance.

The announcement specifies that the applicants must be men, at least twenty years old, and possessed of at least one season's experience in handling range stock, together with at least one year of technical training in specified botanical studies.

The establishment of this position is in line with the objects which the Department of Agriculture has always had in view in its management of grazing on the National Forests. It is not merely seeking to prevent cattle and sheep from doing damage to forest growth and watershed conditions, as they graze on the herbage which is yearly produced in the open forests, parks, and high mountain meadows within the National Forests. Range-fed stock are a matter of decided importance to the American people in these days of rising prices for food products and diminishing supplies, in proportion to population, of livestock, and therefore Secretary Wilson intends that every acre of National Forest range shall be made to produce as much forage as it is capable of doing, consistently with the carrying out of the other purposes for which the National Forests are maintained.

Ever since the Forest Service took over the management of the National Forests, it has been studying the range problem along with its regulation of grazing. In the beginning it was confronted with the fact that a very large part of the range had been badly abused and depleted through the competition of rival owners before any restrictions had been put upon them, and by overcrowding and bad methods of handling stock. Its supporting power had in consequence been greatly reduced, and was steadily declining. To enable overgrazed areas to recuperate, and to prevent the extension of overgrazed conditions to new areas, the amount of stock to be allowed on the forests was everywhere carefully prescribed. The results were then observed, and if it appeared that there was still over-use of the range, the numbers permitted were cut down still further. On the other hand, where recuperation has taken place the allowance of stock has been correspondingly increased.

(Continued on page 958.)

Reclamation Notes

CALIFORNIA.

The Walton lateral, which taps the main irrigation ditch near Sunset, is being extended southerly through the Clark, Krehe and Kerrigan tracts. The ditch will water a large section of country west and south of Encinal station.

Announcement has been made that the Great Western Power Company will build at Big Meadows, in northern California, a reservoir that will surpass in capacity the Roosevelt dam and reservoir in Arizona and the Assouan dam in Egypt. Sufficient water will be stored for the irrigation of 300,000 acres.

Water has been turned into the main ditch and laterals of the Hallwood irrigation district. Four thousand acres of land will be under irrigation when the system is perfected, and it will be possible to extend the benefits to 7,000 acres. The water will be taken from Yuba river at DeGuerre Point.

The United States Department of Agriculture is issuing a report entitled "Irrigation in San Joaquin Valley, California," by V. M. Cone, which is available for free distribution as long as the supply lasts on application to U. S. Irrigation Investigations, Berkeley, California.

Petition was recently granted to Hobart Heiken and others by the Board of Supervisore of Yuba City to form a reclamation district, comprising about 1,100 acres of land near Tudor and to be known as the Independent Reclamation District.

The Moulton Irrigated Lands Company has a force of mechanics busy installing a big centrifugal pump at a point on the east side of the Sacramento River, opposite Princeton. This is one of the Largest pumps, if not the largest, in Colusa County or Superior California, and will throw a stream of water 24 inches in diameter.

Work is moving rapidly on irrigation ditches and general improvement of the irrigation system at Blythe, Palo Verde valley.

Irrigators of Riverside and Orange counties have a force of men diverting over 20,000 inches of water of the Santa Ana River to gravel lands.

The Sacramento Valley Irrigation Company is notifying the farmers that it will again offer prizes this year for best farm development work, as was done last season. The prizes have not yet been made known.

A party of twenty-six Los Angeles capitalists interested in the development of a big irrigation project in the upper end of the Surprise Valley, in Modoc County, made the trip to that extreme corner of the state recently by going practically all of the distance through Nevada. They took the route by way of Goldfield and Reno, Nevada.

A proposition is being considered, which in all probability will be accepted, for increasing the acreage of Reclamation District No. 108 in the southern part of Colusa County. There are now in the district about 40,000 acres and if the work outlined is carried out, it will take in all of the land covered by the old district, thus adding 20,000 acres.

The Northern California Power Company has set a crew of men at work digging a tunnel 6,000 feet long in connection with its Dry Burney conservation and irrigation project. Dry Burney Creek is to be dammed and a storage reservoir of 1,540 acres is to be made. The average depth of the water will be 20 feet and there will be enough of it to generate 6,000 horsepower electrically.

COLORADO.

The County Commissioners have set June 17th for an election to decide on whether a municipal irrigation district shall be established in the Boggs flats section. The project, if carried, will necessitate a bond issue of $5,000,000 and water will be brought from the western slope by a tunnel through the Continental divide.

The right of an irrigation ditch to sell its surplus water to other ditches below its intake was raised in a suit filed in the federal court in Denver recently against State Engineer C. W. Comstock by the heirs of Julia Merritt. Judge Lewis issued a temporary restraining order.

Charged with wrongfully retaining possession of valuable papers, books and securities belonging to the Denver-Greeley Valley Irrigation Company, Frank F. Smith and Bernard J. Ford, former officers of the company, have been made defendants in a petition for a writ of mandamus filed in the district court by W. W. Louden, president of the board of directors, on behalf of himself and all other members.

Smith was removed from the presidency of the board by a majority of his associates April 4, 1911. It is said that Ford's office of secretary was declared vacant in March and Louden was elected to succeed him.

That the Uncompahgre valley project may lose the allotment of $1,500,000 which was made to it from the special $20,000,000 bond issue, unless something is done soon to bring about a unification of the project, was the ultimatum issued to the water users recently by Supervising Engineer Morris Bien. Thousands of acres in this valley have been put in readiness for water, but the work of completing the ditches and the laterals to the land has been held up by the government because all of the private ditches have not been brought under government control. Engineer Bien said many projects in the West are clamoring for money and the secretary of the interior is not inclined to wait much longer for the unification of the Gunnison tunnel project.

E. T. May and L. A. May have deeded their rights in a number of irrigation ditches and reservoirs to the Pueblo Northeastern Irrigation Company of Pueblo. The water rights conveyed will be used to irrigate about 50,000 acres of land northeast of the city under the Pueblo Northeastern company's ditches.

By bringing water from Boyd Lake down the Big Thompson, the Platte and the Empire Canal, irrigation water will be furnished for 20,000 acres near Wiggins and Vallery, in the west part of Morgan county. The only work required to place the water on the land will be the building of nine miles of ditch from the Empire reservoir to the edge of the district. The cost will not exceed $35.00 per acre.

The Howlett irrigation system of Meade, by which several thousand acres will be provided with irrigation, is progressing. Three large reservoirs made by erecting dams across gulches have been connected by a string of ditches. The work will cost $20,000.

Reconstruction work on the Swink and Otero ditches is going ahead with all possible speed. The old flumes and gates are being replaced with concrete work. The force of men is working fifteen miles south of Elder, between Fowler and Swink.

That the effort of the Larimer and Weld Irrigation Company to secure a change in the point of diversion of fourteen second feet of water, recently purchased from the Chamberlain Ditch Company, will meet with stubborn opposition was evidenced recently when the city of Greeley and the Greeley Irrigation Company, joint owners of Greeley No. 3 canal, filed in the district court an answer to the petition of the Larimer and Weld company resisting the application. It is understood that the Hotel mill of Ft. Collins and the Cache La Poudre Irrigation Company will oppose the change.

The preliminary survey of the Bent and Prowers irrigation district was completed last month and L. M. Markham and his party of surveyors returned to Lamar. The entire survey from the Purgatoire river on the west, begin-

ning about eighteen miles south of Las Animas, to Clay creek, some ten miles east of Lamar, has now been completed and the engineers will use the information secured by this survey to perfect final plans, and construction work will begin shortly.

MONTANA.

Formal application has been made for the segregation of 10,000 acres of public land along Flatwillow creek in the eastern part of Fergus county by the Fergus County Land & Irrigation Company, in which are interested John Maginnis of Butte, John Berkin of Butte, David Hilger of Lewiston and other Butte and Lewiston men. The application has been forwarded to Washington by the state Carey land act board.

Fred C. Churchill has been appointed receiver for the Great Falls Land & Irrigation Company of Montana by Judge William Fennimore Cooper in the superior court on application of A. M. Keasey, secretary of the company. An injunction was also asked to restrain A. W. Jeffries & Company, holders of securities and notes of the company valued at $16,000 as security for a loan of $6,600, from disposing of the notes.

For the purpose of widening and making repairs on the Miller and McGirl ditch, about 13 miles east of Billings, E. W. Colton of the Gergarz Engineering Company, has been engaged recently in making a survey and settling the level along the ditch. This ditch is an old one, but has been taxed to its capacity and by the widening of it much more land which was not heretofore under cultivation will be plowed and put into crops each year.

In response to petitions from settlers, made through Senator Dixon, an order has been signed by the secretary of the interior granting extension of the time to water users under the lower Yellowstone reclamation project for making payments of charges of construction, maintenance and water rights.

Litigation in the Sun River case is ended. The decree of the court removes all hindrance to the government improvement by irrigation of that great project. The attorneys stated that by the early part of June the federal government forces will be pushing with great activity the work of irrigating the Sun River benches.

Seven million dollars will be spent by the United States on irrigation projects in the northern part of Montana during the next three years.

The flow of water in the streams of the State of Montana during the irrigating season should be above the normal this year, according to the reports of the snow supply. There has been a heavy fall of snow this winter in the high mountain regions which produce the summer water and this has scarcely been touched by the spring thaws so far.

Notice has been received at the Miles City land office that the recent order providing for stay of proceedings, looking to a cancellation of entries under the lower Yellowstone irrigation project has been recinded and a new order issued.

Assurance has been had from the government that the Sun River irrigation project work will be pushed ahead as soon as the litigation concerning it is out of the way.

NEW MEXICO.

The approval of the Secretary of the Interior of the first New Mexico Carey act project should result in the rapid development of the million acres set aside for such projects in that territory. Thus far the projects under that act, for which so much was promised for the territory, have met with all sorts of delays and difficulties, but the success of the Lake Charlette project in Colfax County should encourage further investment under the liberal provisions of the act.

Another irrigation plan is being tried by Dr. H. D. Nichols on his farm south of Tucumcari. A forty-acre plot will be irrigated by the windmill and the ground is being prepared

for the crop. If the plan is a success, it is probable that a larger acreage will be attempted next year.

The Secretary of the Interior has awarded contract to the Midland Bridge Company of Kansas City, Missouri, for furnishing material and erecting a highway bridge at Elephant Butte in connection with the Rio Grande irrigation project, New Mexico. According to the terms of the contract the work is to be completed within 95 days after notice of award. The contract price is $5,667.

The following dispatch was received by the Reclamation Service from the District Engineer at El Paso, Texas: "Main track completed into Elephant Butte today. Six carloads material and supplies will go over road tomorrow. This will enable hastening the work."

The completion of this railroad branch is of farreaching importance, as it marks the beginning of active construction of the Eagle Dam, the most imposing and important structure yet planned by the Reclamation Service. This dam is to be built in the canyon of the Rio Grande about 100 miles north El Paso. It will be 265 feet in height, 1,400 feet long on top, and will contain 440,000 cubic yards of material. It will create the largest storage reservoir in the world, having a capacity of 2,538,000 acre-feet and flooding 48,000 acres an average of 62 feet in depth. Spread over the surface of Rhode Island and Delaware it would cover both states more than a foot deep.

In addition to the big dam four diversion dams will be required, one of which, the Leasburg, is now in operation and is supplying water to 20,000 acres in Mesilla Valley in New Mexico. Several hundred miles of main canals and laterals will be required to distribute the water over the 180,000 acres included in the project.

Especial interest attaches to this project by reason of the interstate and international features involved. Before work could begin a treaty was made with Mexico to insure to that country a continuation of her prior water right, and a special act of Congress was required in order that Texas might enjoy the benefits of the Reclamation Act. The completion of this work will settle forever the controversy between the United States and Mexico and between Texas and Mexico over the rights to the use of the water of the Rio Grande.

The Valley of the Rio Grande in New Mexico is one of the most fertile in the United States. This stream carries an enormous amount of rich sediment which is of high value as a fertilizer. Abundant proof of this is to be found in the fields which are said to have been in cultivation for more than a hundred years in cereal crops, without any perceptible diminution in annual yields. The public lands are withdrawn from entry until the irrigation works are completed.

OREGON.

The Thompson-Hartman Company of Portland, promoters of the irrigation project from West Stayton to Turner, have a large force of men and teams at work. They expect to have between 800 and 900 acres under irrigation by June 1st. This certainly means much to Turner.

Another reclamation project is about to be undertaken in Umatilla County and 20,000 acres more of arid and semiarid land are to be brought under profitable cultivation. The undertaking is known as the Camas Creek, though the lands to be reclaimed are in the Butter Creek Valley.

Great progress is being made in the preliminary work on the west side extension of the Umatilla irrigation project. The force at work on the test pits for the dam has been doubled, and they are now at work on a site about a mile up the river from the place originally selected for the dam.

Of the great irrigation enterprises that are reclaiming thousands of acres of soil near Weiser mention is especially due the work of the Crane Creek Irrigation Company. This company is engaged in constructing an irrigation system that will deliver water to 22,000 acres of land almost immediately adjacent to Weiser.

The Stayton irrigation project recently took another step toward the completion of the system when the promoters filed a suit in condemnation of a right of way through the property of Lucy J. Kearns. It is claimed that the defendants in the case want about $500 per acre for land that cannot possibly be sold for more than $150 per acre at the present time.

One of the greatest irrigation sections ever planned near Sumpter, Oregon, is being discussed. It is said to be the solution of the problem of irrigating the vast territory of lower Powder River valley by submerging a large portion of the smaller Sumpter valley. The carrying out of this project would involve the buying up of nearly all the farm lands in the small Sumpter valley to secure a right of way to use it as an immense storage basin for holding water.

The enginers in charge of the Umatilla irrigation propect, Oregon, reported that all field work in connection with the proposed west extension would be completed by the end of May. Investigation at the various dam sites indicate that a reasonably economic structure can be built providing rights of way are not exhorbitant. Preliminary plans will be completed so that a final decision can be made probably by the middle of the summer. All the farms in the fourth unit, opened to entry on March 22, have been filed upon, and only five remain unentered under the third unit. Receipts on account of water right charges have been very satisfactory, there being few delinquents. During April water was diverted from the Umatilla river with few interruptions, and on the last day of the month the water reached the spillway lip of the Cold Springs reservoir, which was entirely filled. Sufficient water is now being diverted from the river to maintain the level in the reservoir and to supply irrigation needs.

UTAH.

The maintenance and operation charges for 1910 on the Carlsbad irrigation project have been paid on the entire area, except for 94 acres, and water for the present season has been delivered continuously since March 27th. There is more land under cultivation on this project this year than ever before, and there has been a large increase in the acreage planted to cotton, due to the phenomenal success of last year, when as high as $90.00 per acre was realized from this crop. The cutting of the first crop of alfalfa is now under way.

On May 15th Ft. Sumner and vicinity was visited with a heavy downpour of rain, the precipitation measuring about an inch. This practically assures a bumper crop and a fine range this summer.

Application has been made to the territorial engineer, Charles N. Miller, by Tumcumcari promoters through Herman Gerhardt as their representative, for the right to dam Pajarito canyon, eight miles west of that city for irrigation purposes. Diversion and storage dams will be built to hold 60,000 acre feet of water, with an irrigating capacity of 30,000 acres of farm land, truck gardens and for domestic use.

Construction work on the Meloche dam is progressing rapidly, fully one-third of the concrete for the dam's cement core having been laid and the earth embankment filled in as rapidly as progress on the cement work permits.

One of the biggest private irrigation enterprises in the southwest is under way at Terra Amulla. The famous Terra Amulla land grant comprises some 500,000 acres of rich virgin soil, thousands of acres of fine irrigable lands, meadow lands, grazing, mineral and timber lands, located principally in Rio Arriba county in northern New Mexico and running over into Archuleta county in southern Colorado.

Forty men and teams have been put to work on the Hammond-Farmington canal in San Juan county.

Dr. R. Heermann of Roswell, received a twenty-horsepower Venn-Severin crude oil engine with which he will start something new in the line of land development in the Pecos valley. He will endeavor to pump water from a depth of eighty feet and irrigate his farm of 160 acres. Pumping water from such a great depth will be watched with great interest by the people along the Pecos. If successful, Dr. Heermann will be a rival for honors with the first man who

drilled an artesian well in Roswell. A No. 6 American centrifugal pump with a minute capacity of 1,100 gallons will be used.

The state land board has granted the application of the Green River Irrigation Company of Castledale for the temporary segregation of 165,000 acres of land on either side of the Green rivers in Grand and Emery counties. The company proposes to obtain water by building a diverting dam twenty or thirty miles up the Green river from the first upper acreage and carry the water by gravity ditches and flumes down either side of the stream to the land. The company proposes to spend $5,000,000 to put water on this land.

Articles of incorporation of the T. H. Dodd Irrigation Company of Hayden have been filed with the secretary of State. The company is capitalized at $1,040. The company will engage in a general irrigation business.

E. T. Merritt of Salt Lake and W. T. Chamberlain and P. H. Lund, an irrigation engineer, both of Denver, have taken over a tract of 10,000 acres of fruit land 106 miles west of Grand Junction, in the Green River valley, and have begun the construction of a sub-irrigation plant.

The irrigation project in the Pecos Valley, under the direction of F. A. Hornbeck, land commissioner of the Orient Railroad, has been completed and water from the Pecos river turned on to 25,000 acres of land.

The Secretary of the Interior has withdrawn from entry for all purposes all of Sections 13, 14, 23, 24, 25 and 26 in township 4 south, range 11 west, Uinta Special Meridian, Utah. The lands thus included are necessary in the construction of the Strawberry Valley reservoir as they contain materials required for the Strawberry Dam.

It is reported that work will begin on the Spanish Valley irrigation project as soon as the 8,000 acres of government land, which it is to irrigate, are segregated under the Carey act. The project, which is to cost in the neighborhood of $750,000 is fully financed.

Work has been commenced on the Bountiful-Stone Creek Irrigation Company's project on the south bench above Bountiful. The company"s object is to conserve the water of Stone Creek, and to this end 18,000 feet of eight inch pipe will be laid.

WASHINGTON.

The Pasco Reclamation Company is disposing of large tracts to eastern buyers. Many of the purchasers will settle immediately to improve their land, while others are taking advantage of the improvement contract offered by the company, which agrees to plant trees and care for them until ready to bear.

Indicating that Yakima Valley irrigation plants have passed their experimental stages and that permanent work is being installed, 85,000 feet of concrete pipe is being manufactured and installed in the Yakima Valley this year by the Cement Products Company, three plants being kept in operation.

The Lake Chelan Land Company, which is promoting the Wapato irrigation project, has purchased the Peter and John Indian allotments on the north shore of Lake Chelan and the Methow Valley Irrigation Company has secured the consent of all the heirs of the Antoine allotment, seven miles northeast of Chelan, to the sale of that tract to the Methow company.

Water has been turned on by the irigation companies in the locality of White Bluffs and electric power is on the wires of the Pacific Power and Light Company for the private pumping plant. The Hanford Irrigation Company started its big pumping plant at Coyote Rapids, ten miles above White Bluffs, at midnight March 20th and water reached the White Bluffs irrigators over the company's local distributing system at 9:00 o'clock Friday morning.

Members of the Sandy Irrigation Company met recently at Sandy and elected the following officers for the ensuing year: W. W. Wilson, president; Charles Linden, vice-president; A. M. Nelson, treasurer; David E. Greenwood, secretary, and Peter Hanson, director.

The Western Land Irrigation Company of Centralia has filed water rights with the county auditor for one cubic foot of water per second from Scatter Creek. According to the document filed, the company is to use the water for irrigating prairies.

MISCELLANEOUS.

The Secretary of State of South Dakota has issued a charter to the Southwestern Land and Irrigation Company, having headquarters at Huron. The company is capitalized at $100,000.

The Porto Rico Railways Company, Ltd., has employed the Ambursen Hydraulic Construction Company of Boston, Mass., as engineers for the construction of a dam 125 feet high and 350 feet long for impounding storage water for their present hydro-electric power plant near San Juan. Work will commence immediately.

The secretary of the interior has awarded contract to the Illinois Steel Company of South Chicago, Illinois, for 1850 tons of 60 pound steel rails for use in constructing a branch railroad to Arrow Rock Dam, Boise, Idaho, irrigation project. The contract price is $64,306, f. o. b. cars, South Chicago.

Irrigation is to be fully tested out in Central West Texas. The Stamford interests have installed machinery fifteen miles below Stamford and are using the Brazos River as a source. They have ditched for irrigation some fifty acres of land. If this first experiment is satisfactory, they will experiment on a very large scale.

D. Clem Deaver, an Omaha man, has been chosen to pull the lever of the mighty Shoshone project dam just completed in Wyoming by the United States Reclamation Service, which will put in operation one of the most wonderful irrigation services in the world. The great event will be held June 23rd, almost an even five years after the day on which the dam was started.

One of the big irrigation projects in the northwest part of South Dakota, which has not been receiving the attention of the Big Belle Fourche project, but which will be a work of considerable magnitude of itself, is a project on the Little Missouri in Harding County, which will care for a large acreage in the valley of that stream.

A big irrigation well, recently completed on the ranch of A. D. and Paul E. Walker, north of Fowler, Meade County, Kansas, tested to flow 60,000 gallons per hour and is steadily increasing. It is in the famous alfalfa district of Meade County and will irrigate half a section of alfalfa.

The general storm which visited the North Platte Valley on April 29-30 was of enormous benefit to the farmers. It put the soil in proper shape for spring planting and gave the winter wheat and alfalfa the good wetting needed. Spring opens on the North Platte project with the settlers in general cheerful and hopeful and hard at work on their farms. The prospects for good crops are bright. At the present time the canals are supplying 26,000 acres. Extension work has been going forward during April on the High Line Canal and the additional sites. One hundred men and teams are constantly employed.

Boys and young men in the Kansas agricultural college are getting practical experience this term in the class of irrigation and drainage. In addition to the regular instruction the students see the work now in progress on a tract of land adjoining the college farm.

Work of straightening the Little River in Oklahoma Territory, which traverses Pottawatomie County from east to

west is started. The total cost will be $250,000. It is estimated that 26,000 acres of land, now virtually worthless, will be made tillable.

Eight thousand dollars will be spent by the state of Kansas and the federal government upon irrigation experiments in the western part of that state this summer. Experiments will be carried on at Garden City under the direction of government irrigation experts.

Nearly 1,000 acres of land which is under the Aberdeen-Springfield Canal was filed on at a sale held in Springfield on October 27th. The original tract embraced 80,000 acres, and with this sale the remaining acreage, which has not been taken up, is reduced to 8,000 acres. Value is added to the land by the fact that no reservoir is used to store water to cover this tract. It being the first Carey Act project in the state of Idaho, it has water rights which only the drying up of the Snake river can hinder. Water is taken direct from the river through a well constructed canal for many miles to the south, where it is diverted into two canals, one carrying the water over the high land and the other to the lower lands.

An act to provide for the safeguarding of the rights of persons conserving public waters in reservoirs and prohibiting the misappropriation of such waters, was introduced in the House of Representatives of Utah recently by Rock M. Pope. The bill provides that wherever an owner of a reservoir desires to use the bed of a stream for carrying stored water, he must notify the State Engineer in writing, giving the date when it is proposed to discharge the water, its volume in acre-feet and cubic feet per second, the point of discharge and the names of persons and ditches entitled to its use. A special deputy will then be appointed by the State Engineer to adjust the head gates of all ditches not entitled to stored water in such manner that those having the right to use the water shall receive the volume to which they are entitled. For the purpose of delivering the stored water the deputy may, with the approval of the State Engineer, employ as many assistants as may be deemed necessary.

The Consolidated Reservoir and Irrigation Company has taken over the holdings of the Big Valley Irrigation Company, the Grand Falls Lake and Reservoir Company and the Grand Falls Mutual Irrigation Company, all situated in western Texas. The consideration was about $600,000.

Work is being rushed on the big canal of the Valley Reservoir Irrigation Company, which is to water the lands about Chapin, Texas. Five cars of machinery for the pumping plant were unloaded recently and are being placed in position as quickly as possible.

Hilton & Company, of Powell, Wyoming, were the lowest bidders for the construction of the north canal of the Belle Fourche irrigation project in South Dakota. This canal will run twenty-four miles from the Owl creek dam to the Newell district.

At the annual meeting of the Brownsville Irrigation Company of Brownsville, Texas, the following officers were elected: A. W. Gardiner of Houston, president; Lon C. Hill of Harlingen, vice-president; A. W. Wood, Brownsville, secretary and treasurer.

Reclamation work at Project spur, about 20 miles from Hazen, Nevada, has been commenced by a party of 30 men under the direction of U. S. Engineer Tillinghast. Work will be started on the dam as soon as spring opens, when it will be necessary to employ a large force of men.

In the system of irrigaation under construction by the Canadian Pacific Railway, 1,586 miles of canals and ditches have been completed, the contemplated project totaling 4,500 miles. The total expenditure will be about $16,000,000, irrigating a tract of 3,000,000 acres.

The Cotton Land & Water Company of Tucson, Arizona, announce that work will begin on the reclamation of 50,000 acres of irrigable land in Mojave valley, California. Concrete channels will be built from the Colorado river and pumping plants will be established.

An irrigation project, which will result in the reclamation of 50,000 acres of dormant land in Elko County, Nevada, has just been started under the direction of Engineer Van Nagle, assistant to State Engineer Kearney, and representatives of the Pacific Reclamation Company. The proposed project is for storing the waters of Marys River and irrigating lands under the Carey act lying east of the river and extending across Taber Creek to the lands irrigated by Bishop Creek.

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GOVERNMENT WITHDRAWALS OF PUBLIC LANDS.

Four new water power-site withdrawals, embracing 7,549 acres, were made during the month of March as a result of the field investigations of the United States Geological Survey. A total of 1,400,571 acres now stand withdrawn for power purposes, in the following States:

	Acres.
Arizona	107,550
California	53,689
Colorado	204,583
Idaho	231,698
Minnesota	3,619
Montana	126,047
Nevada	15,375
New Mexico	9,706
Oregon	161,777
Utah	347,252
Washington	80,386
Wyoming	58,889
Total	1,400,571

Two years ago last December the Government awoke to the fact that American phosphate lands were being largely exploited for the benefit of foreign users of this precious mineral fertilizer, over half of the American production being exported; also that the public phosphate lands were rapidly passing into the hands of private owners. Large areas of lands underlain by phosphate rock in the recently discovered fields in the public-land states were immediately withdrawn with a view to securing legislation which would prevent exportation of the phosphate. Since then important geologic investigations have been prosecuted and new deposits of phosphate discovered by the United States Geological Survey. The area now standing withdrawn is over two and a half million acres, containing an aggregate of many hundred million tons of phosphate rock and having a very great potential value to the farming industry.

To make this phosphate rock readily available as a plant food it is necessary to treat it with sulphuric acid, thus converting it into acid phosphate, or "super-phosphate," and it is an interesting fact that at least one of the areas withdrawn is in close proximity to the western copper smelters where large volumes of sulphuric acid fumes are now a daily unutilized by-product.

The following table shows the acreage and location of the Government's phosphate areas standing withdrawn from public entry on April 1:

	Acres.
Montana	33,950
Florida	37,439
Idaho	1,101,517
Utah	107,746
Wyoming	1,267,494
Total	2,548,145

The petroleum lands in the public-land states constitute one of the most important natural resources remaining in the hands of the Federal Government. As a result of investigations by the United States Geological Survey large areas of these lands have been withdrawn from public entry pending legislation needed to prevent their wasteful exploitation. On April 1, 1911, these withdrawn oil lands aggregated nearly 4,000,000 acres. The states in which they are situated and the acreages are shown below.

	Acres.
Arizona	230,400
California	1,594,332
Colorado	87,474
Louisiana	414,720
New Mexico	419,901
Oregon	74,849
Utah	581,566
Wyoming	392,306
Total	3,795,548

(Continued from page 949.)

The proposal to appoint specialists who are both thoroughly trained botanists and men of practical experience in range matters indicates recognition of the fact that to attain the highest point of range productivity the best scientific knowledge must be applied to the study of the problems of forage production and utilization. As stock graze on the range, the effect on the different kinds of vegetation differs both with its palatability or unpalatability and with its capacity to produce seed, its time of seeding, its resistance to trampling, its manner of growth, and many other elements.

What is aimed at now is nothing less than to find out all the things on which depend the production of the largest amount of beef, mutton, wool, and hides on a given area. This involves learning how both to restrict and to time the grazing so as not to interfere with the reproduction of the most valuable elements in the forage crop, how to prevent unnecessary loss to feed through trampling and in other ways, how to exterminate poisonous plants from the range, how to prevent the loss of forage which results from the multiplication of prairie dogs and gophers, whether it is practicable to introduce new forage plants by direct seeding, and many other matters. It is to look into such matters that the grazing examiners are to be appointed.

Besides seeking to bring about the recuperation of depleted ranges, the reduction of waste, and the development of all range to what may be termed an artificial state of productiveness through control of reproduction, accompanied, it is hoped, by the introduction of new forage plants, the studies planned will aim also at increasing the area of range available. There is much natural grazing land in the National Forests which can not be put to use, either because the country is too rough for stock to be driven in, because shipping facilities are lacking, or because of a lack of water. The construction of properly located roads and driveways and the development of water through the building of reservoirs or the driving of artesian wells are a part of the general scheme of permanent improvements planned for the National Forests. To furnish the basis for comprehensive development of the grazing resource the range will be studied in detail, classified according to the type of vegetation found, and mapped by "forties." The observations made will include notes for each forty acres upon the surface, soil, character and density of vegetation, evidence of overgrazing or under-use, presence of poisonous plants, damage by range-destroying animals, water facilities, and accessibility. With such data in hand it will be possible to bring about much more intelligent and intensive use of the National Forest range.

DESIRABLE LAND FOR SALE IN MONTANA.

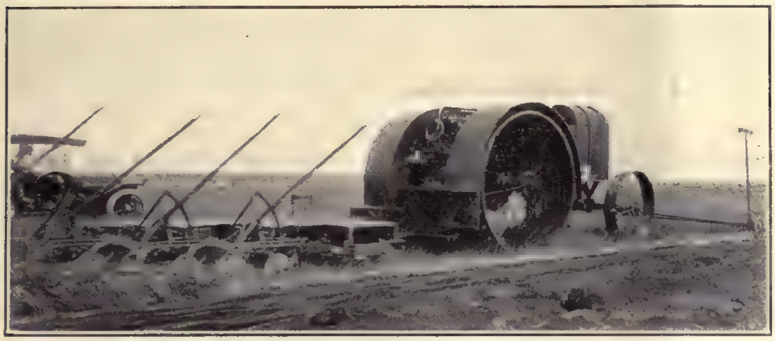
640 Acres—Three miles east of Canyon Ferry on the extreme lower end of the Missouri valley and Broadwater county, 8 miles north and east of Winston and 15 miles due east of Helena. This tract is 98 per cent tillable, and in what is known to be one of the very finest Dry Farming Districts in the state. Last year an adjoining ranch made 35 bushels of wheat to the acre. This would make an exceptionally fine wheat ranch, and which is a bargain at the price of $20.00 per acre, one-half cash, and the balance in five equal annual payments, with interest at the rate of 6 per cent.

320 Acres—Six miles south and east of the above described tract which is 8 miles due east of Winston. This small ranch is located in the heart of one of the finest Fruit Districts in our state. A few miles north is an orchard of 15 acres which bears large crops of apples annually, the apples being unusually large and of an exceptionally fine flavor and color. There are other small orchards south and west. Lying close as it does to the mountain would make an excellent ranch for Live Stock. This tract is 90 per cent tillable. Domestic water could be had the year round. The price is $22.50 per acre, one-half cash, and the balance in 5 equal annual payments at the rate of 6 per cent interest.

Address all inquiries to W. E. Crowley, care Irrigation Age, Chicago.

VIEW TAKEN DURING AGRICULTURAL MOTOR COMPETITION AT WINNIPEG.

Here is an interesting snapshot taken at the Agricultural Motor Competition at Winnipeg. It shows the gold medal winner, the Big Four "30," pulling seven 14-inch breaker bottoms in very tough gumbo ground, the engine running alone, with engineer and judges walking behind and others following in an automobile. In the breaking contest the gold medal winner broke twelve and one-half acres four inches deep, on two and one-quarter gallons of gasoline per acre, in a six-hour nonstop run. The average drawbar pull was 7,000 pounds and more than once 10,000 pounds was registered. In the belt brake test, the Big Four "30" delivered 48 horse power for two hours, using only .956 pints of gasoline per horse power hour. In the half-hour maxims belt brake test, the engine developed 57 horse power. Neither in the brake test nor the breaking demonstration was the engine charged with using one drop of water.



This year's Agricultural Motor Competition is being looked forward to with a great deal of interest by farmers, engine owners and others interested in farm tractors. As the only contest of its kind held in the world, its tests are regarded with great interest, and honors won are highly regarded by manufacturers of both steam and internal-combustion tractors.

PAYMENTS ON IRRIGATION HOMESTEADS.

The Reclamaton Service requires one-tenth cash payment on irrigated homesteads at the time of filing, and one-tenth each year until the full payment is made. They also require one year's maintenance fee to be paid in advance. Where the water right is $46 per acre it requires a considerable sum of money to file upon 80 acres, and a man must have quite a little money before he can undertake to go through with an 80-acre homestead. A bill is now before Congress providing in the future only $1 per acre shall be required at the time of filing, $1 per acre the next year, $2 per acre the third, fourth and fifth years, $3 per acre the sixth, seventh and eighth years, and $5 per acre each year thereafter until the full amount is paid.

The United States Reclamation Service has begun a series of important experiments on the government irrigation project at Carlsbad, New Mexico, with the use of crude oil as a cement for irrigation canals instead of the expensive concrete now in general use throughout the West. The oil used is of the heaviest grade that can be purchased and it is smeared thickly over the bottom and sides of the canals. It is believed that it will effectively prevent seepage, and if so, will result in an enormous saving in cost of irrigation construction all over the West.

ENOUGH POWER HERE TO PLOW A SECTION AND A QUARTER IN ONE DAY.

They're "on their way" to Canada—forty one *modern farm horses.* This train of twenty-two cars was one-third of a shipment of one hundred and thirty Hart-Parr Gas Tractors ordered this spring by the farmers of Manitoba and Saskatchawan, Cenada. The value of the three shipments exceeded $300,000. The route was over the Chicago, Milwaukee & St. Paul from Charles City, Iowa; then over the Great Northern from St. Paul; then by the Canadian Northern to Portage La Prairie, Manitoba. These three shipments of gas tractors sent to one point are the biggest in the history of the world. The demand for Hart-Parr Tractors is a remarkable testimony to their efficiency.

These tractors were delivered to farmers all over the two big provinces and are now at work breaking sod or doing regulation farm work once handled so slowly by horses. Just think! Enough power to turn 800 acres in a day, or a section and a quarter. What does it indicate regarding the tremendous growth of the Canadian Northwest? Canadian farmers *nowadays* think a long time before they buy twenty or thirty expensive horses to carry over all winter—then find them soft and unequal to the heavy demands of spring work.

In these sections horses are very expensive. The number of days they can work is shorter than in the United States. They break down under the excessive strain of early spring work and have been proven a source of great loss to the grain farmers of these provinces. This is one of the reasons why Hart-Parr tractors are so popular.

TRAIN LOAD OF HART-PARR ENGINES.

The Hart-Parr Company has just issued a new book, "Plowing and Tilling With a *Modern Farm Horse.*" It's a good book to have. It explains costs and uses of a gas tractor, compares daily work-costs of steam, horses and gas tractor. Makes suggestions for home-constructed hitches for drills and harrows. Address them at Charles City, Iowa.

IRRIGATION NEAR FALLON, NEVADA.

General conditions on the Nevada project are more satisfactory today than ever before. The settlers, who comprise an unusually intelligent class of farmers from all over the United States, have bravely met and overcome most of the difficulties encountered in a new and arid country and many which were peculiar to that region only. The discouragements of the first few years are being forgotten in the abundant returns which are now rewarding their efforts. The past two years have demonstrated beyond question the agricultural value of the land, and the crops grown on 32,000 acres last year furnished convincing evidence of the fertility of the soil. The main crops were alfalfa and grain; the former yielding frequently as high as six tons to the acre in three cuttings.

One of the serious problems on this project which was early foreseen by the engineers is that of drainage. Drainage ditches parallel the irrigation canals on many parts of the project. With the application of large quantities of water to the land and the rise of ground waters resulting therefrom, these ditches must be deepened and extended. The board advises that it may be necessary in the future to install a number of wells from which water will be pumped for the double purpose of lowering the ground water and increasing the supply for irrigation.

As the irrigation canals are only used in a few instances during the winter, they act as drainage canals during the winter months, thus lowering the stage of the ground water. The enforcement of a more economical use of water will also serve to correct the drainage evil. The engineers are considering the feasibility of installing a hydro-electric power plant at Lahontan Dam for supplying water to certain vested rights, to provide power and light and an adequate water supply for the growing city of Fallon. As the Truckee River General Electric Company has withdrawn from the negotiation for control of Lake Tahoe, it is expected that condemnation proceedings will be pressed in the near future, in order to insure the project against a shortage of water during the next three years.

The Temple Irrigation Equipments the most Economical and Certain Means of Lifting Water

55 YEARS' EXPERIENCE

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CENTRIFUGAL PUMP AND GASOLINE ENGINE IRRIGATION OUTFIT

The Temple Water Elevators—The Temple Centrifugal Pumps

Manufacturers of all kinds of Hand and Windmill Pumps

Also Manufacturers Single Cylinder, Double Cylinder and Four Cylinder Gasoline or Kerosene Engines

Briefly stated the advantages of our Double Cylinder Engines are as follows:

First—They are more economical in the use of fuel. On light loads one cylinder can be used, reserving both cylinders for heavy loads.

Second—Although weighing about one-half the weight of a single cylinder engine of same rated capacity, vibrations are practically overcome, demonstrating conclusively that in proportion to strain, the double cylinder "Master Workman" is the stronger engine.

Third—The heavier weight of a single cylinder engine is due to the fact that it must have heavier fly wheels in the horizontal type, and a longer, higher and consequently much heavier base than is required for the "Master Workman." The heavier the fly-wheels the greater the strain on the crankshaft, so you will realize that neither heavier fly-wheels nor a heavier base contribute one iota to the strength of a single cylinder engine.

Fourth—When vibrations are overcome, as in the "Master Workman," the lighter the engine and the less cumbersome it is, the greater its sphere of usefulness and the cheaper and more convenient it can be handled.

Fifth—Lubrication in our engine is absolutely perfect. There is no forced lubrication, lubrication being by gravity. Certainty of lubric ion is of vital importance in the steady running and operation of a gasoline engine.

Sixth—All mechanism is in full view, which will enable you to thoroughly understand the operation of a gasoline engine. The worst kind of complexity is concealed mechanism.

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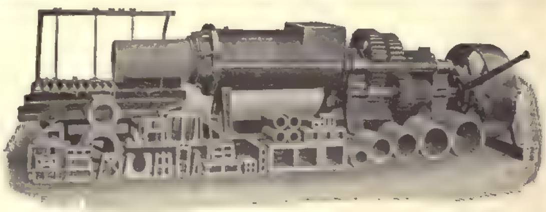
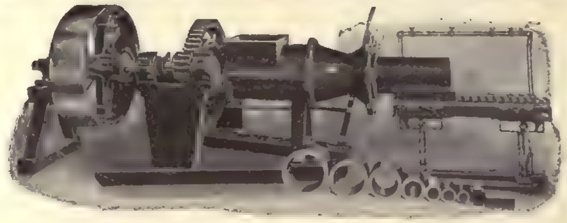
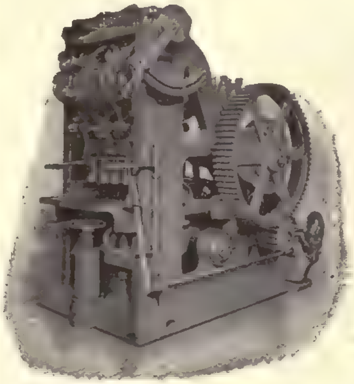


Centennial Auger Machine

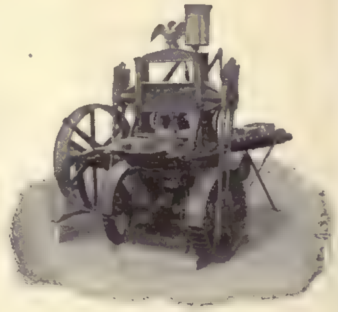


Mascot Auger Machine

Wheelbarrows and Trucks



Dry Press, 5 styles



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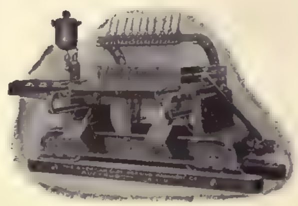
"BUILT RIGHT—
RUN RIGHT"

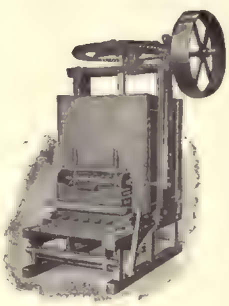
We build an entire line of Clay Working Machinery for the manufacture of Clay products by all processes, including Sand-Line Brick. Our yard supplies are the best. Kiln Irons, Cutting Wire and all supplies. Send for information or catalogue.

The American Clay Mch. Co...Bucyrus, Ohio

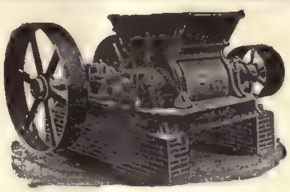
Dry Cars, all kinds



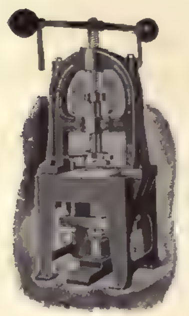
Hand and Power Cutters



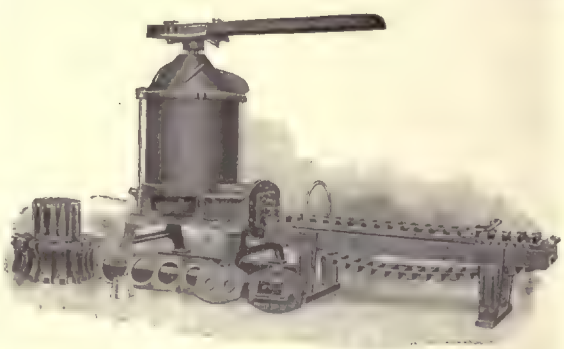
Soft Mud Machines, Horse and Steam Power



Disintegrators



Hand Power Screw Press



Horse Power Plunger Machine

Products of our Auger Machines

$90,000 Daily

Now Spent for No-Rim-Cut Tires

Over 600,000 already sold—enough to equip 150,000 cars. All because they cut tire bills in two.

The sale of Goodyear Tires has multiplied six times over in the past two years. Last year they jumped to $8,500,000. They are now running double last year.

Sixty-four leading motor car makers have contracted with us for these tires. To supply them and tire dealers we are running our factories twenty-four hours per day.

The reason lies in a patented tire—the No-Rim-Cut tire—10 per cent oversize. Men have found that this tire saves one-half on their tire bills. And the tire has become the sensation of motordom.

The No-Rim-Cut Tire

Here is the Goodyear No-Rim-Cut tire as it fits any standard rim. When you adopt this tire you simply reverse the removable rim flanges so they curve outward. They curve inward with old-style tires. This change can be made in ten seconds.

The rounded edge of the flange then comes next to the tire, and rim-cutting is made impossible.

No Hooks on This Tire

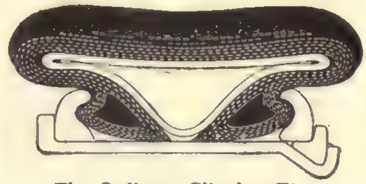
The ordinary tire—the clincher tire—has hooks on the base to hook into the rim flange. That is how the tire is held on. See the next picture.

When you use this type the removable rim flanges are set to curve inward. Note how they dig in when the tire is deflated. That is why the common tire will rim-cut if you run it flat.

Ordinary Clincher Tire

The No-Rim-Cut tire has no hooks on the base. It is held to the rim by flat tape, made of 126 braided wires, vulcanized into the tire base. These make the tire base unstretchable.

The tire can't come off because the base can't stretch. Nothing can force it over the rim. But, when you unlock and remove the rim flange, the tire comes off like any quick-detachable tire except that it won't stick.



The Ordinary Clincher Tire

This braided wire feature is controlled by our patents. And there is no other way known to make a safe tire which will stay on without hooks.

10% Oversize

These No-Rim-Cut tires, where the rim flanges flare outward can be made 10 per cent over the rated size and still fit the rim. And we give you that oversize without extra cost.

That means 10 per cent more air—10 per cent greater carrying capacity. And that, with the average car, means 25 per cent more mileage per tire.

These two features together—No-Rim-Cut and oversize—will double the service one gets from a tire under average conditions. Yet Goodyear No-Rim-Cut tires cost no more than other standard tires.

Our latest Tire Book, based on twelve years spent in tire making, contains many facts which motorists should know. Please ask us to mail it to you.

GOODYEAR

No-Rim-Cut Tires

THE GOODYEAR TIRE & RUBBER COMPANY, Eighty-Third St., Akron, Ohio

Branches and Agencies in 103 Principal Cities *We Make All Sorts of Rubber Tires*

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A Tractor for 160 Acre Farms

RUMELY OILPULL TRACTOR LA PORTE IND.

**Type "F"
15 Brake—
30 Tractive H. P.**

OUR agriculture must now become more intensive. Cultivation of the soil must be more thorough, and this requires more power. Forage plants must be chopped, corn shredded and shelled, water supplied in abundance, in addition to threshing work. All this calls for engine power.

In many districts great advantage can be gained from deep plowing in liberating the fertility of new soil. Discing and thorough harrowing prepare a good seed-bed, and pulverizes the soil so as to retain moisture. For the best returns it is not only important that these operations be done but that they be done at exactly the right time.

The advantage of an engine on the small farm is that it can be worked long hours and a large area covered just at the right time. When idle it consumes no fuel and requires no attention.

Two boys doing the work of 4 men and 12 horses

The farmers in the Central Western States are beginning to recognize that animal power is slow, and that the increased number of horses required by the newer methods of farming are expensive and necessitate setting aside some of the most valuable land for raising their hay and grain feed.

Our Type "F" Corn Belt Tractor develops thirty horsepower in the brake and fifteen in its drawbar. This tractor was designed especially to meet general needs of the smaller farms, and also for use in the Northwest for discing, seeding, harvesting, hauling, and similar lighter operations. It will pull four bottoms in breaking; six in plowing. From ten to fourteen acres a day can be plowed and harrowed in one operation. It turns short, and will work closely into the corners. It has reserve power and can draw upon its fly-wheel in overcoming hills and obstructions.

Threshing with a Type "F" and Rumely Ideal Separator

OilPull Type "F" has the power of 15 good draft horses, the endurance of 50, and costs less than 10. Any farmer working 160 acres can use such an outfit with profit.

Two good-sized boys with one of these tractors can easily do the same amount of work that twelve horses and four men will do in a day. The "F" Tractor will run any size separator up to 32 inch. It will operate a corn husker, sheller, shredder, or any similar machinery.

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M. Rumely Co. :: 1761 Main Street La Porte, Ind., U. S. A.

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DRAG-LINE EXCAVATORS
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All sizes and styles.

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There is nothing made so adaptable for out-door sleeping. It is practical, light, portable, bug proof, fly proof, sun and shower proof. Just the thing!
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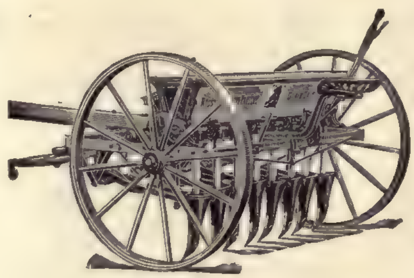

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Plain and Fertilizer

HOOSIER HOE DRILLS HAVE BEEN STANDARD FOR MORE THAN 50 YEARS

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Supplied in all Styles and Sizes.

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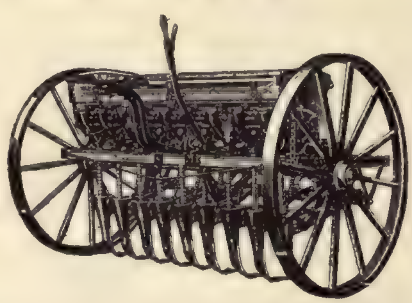

Twenty-sixth Year

THE IRRIGATION AGE

VOL. XXVI CHICAGO, JULY, 1911. NO. 9

THE IRRIGATION AGE

With which is Merged

MODERN IRRIGATION THE DRAINAGE JOURNAL
THE IRRIGATION ERA MID-WEST
ARID AMERICA THE FARM HERALD

D. H. ANDERSON
PUBLISHER,

30 No. Dearborn Street, - - CHICAGO
Old No. 112 Dearborn St.

Entered as second-class matter October 3, 1897, at the Postoffice at Chicago, Ill., under Act of March 3, 1879.

D. H. ANDERSON, Editor

ANNOUNCEMENT.

"The Primer of Irrigation" is now ready for delivery. Price, $2.00. If ordered in connection with subscription, the price is $1.50.

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Official organ Federation of Tree Growing Clubs of America. D. H. Anderson, Secretary.

Official organ of the American Irrigation Federation. Office of the Secretary, 212 Boyce Building, Chicago.

Interesting to Advertisers.

It may interest advertisers to know that The Irrigation Age is the only publication in the world having an actual paid in advance circulation among individual irrigators and large irrigation corporations. It is read regularly by all interested in this subject and has readers in all parts of the world. The Irrigation Age is 26 years old and is the pioneer publication of its class in the world.

CONTENTS.

Irrigation Statistics Are a Desirable Feature

By act of Congress, dated February 25, 1910, it is provided that the Census Director provide for the collection of full information concerning the location, character and cost of irrigation enterprises, no matter whether they are national, state or private concerns; also the area of the land irrigated and the prices at which land with water rights can be obtained and the quantity of water used for irrigation.

The Census Bureau has just issued a preliminary statement for the state of Washington, comparing irrigation data of 1899 with 1909, and an abstract of this statement appears elsewhere in this issue. The principle of the government gathering complete and reliable data bearing upon this important subject is a thing very much to be desired and meets, without doubt, the approval of all interested.

It is to be hoped, however, that statistics will be issued within reasonable time after the date of the reports, so that the information given will be not too far back for utility. The bulletin just issued by the government covers the year 1909, and as this is 1911 the data given refers to a period of one and one-half years ago. However, the task is a big one and if satisfactory results are expected it must be conceded that time and work are essential to obtain them.

After the work of taking the Irrigation Census is fully established its value will become greater from year to year as the comparisons which can be drawn between the various periods of the state, or between various states during the same periods will be of vital importance.

The Curbing of Express Companies Necessary

Much has been done in recent years in the direction of providing for equitable freight and passenger rates within the United States, and many abuses and discriminations that formerly existed have been corrected. Although the railway companies at the time the Interstate Commerce Commission was first established raised fierce objections and predicted dire results and panics due to the interference by the government with the business of the common carriers, they have finally submitted gracefully, and some of them admit even that the Interstate Commerce Commission is really a blessing in disguise. It is true that the Interstate Commerce Commission, in conjunction with the different state railroad commissions, has brought the transportation business of the United States nearly to the point where it ought to be.

It seems almost inexplicable why Congress, when the Interstate Commerce Commission was first established, did not give it jurisdiction over the different express companies as well. They are common carriers, just as much as the railways, and yet they have been permitted to charge exorbitant rates to the public year after year, long after the railway companies had been compelled to make substantial reductions in both freight and passenger rates. Not only have these express companies enjoyed a very remunerative monopoly, but they have very effectually blocked all legislation for a parcels post conducted by the United States government. In most other civilized countries the general government runs the parcels post as an adjunct to the mail service, and express companies are entirely unknown quantities. The rates which are charged for the carrying and delivery of parcels are very moderate, in fact less than one-fifth of the charges of express companies in the United States.

With these considerations it seems that the time for action is ripe and there has now started an organized movement toward the regulation of express companies. During the recent convention of the National Association of Railway Commissioners, held in Chicago, a committee was appointed to study the problem.

While it is a desirable step to have an adjustment of express rates, the real solution will be the establishment of a parcel department by the United States mail service. When this is done there will not only be a large reduction in the transportation charges, but it will bring the parcels post directly in touch with everybody by means of letter carriers and rural free delivery, while under the present system people living remote from the railway stations not only have to pay the heavy express charges to the nearest railway station, but are also under the obligation and additional expense of transporting their packages from the express office to their homes.

It certainly looks as though the time was ripe to remove the express companies from off the back of the common people and give them better service for smaller cost either by a greatly modified express system or by the development of a parcels post service.

Everything in the realm of nature occurs according to fixed and immutable laws; it is only our ignorance which prevents our grasping such laws or their application.

* * *

The "Primer of Hydraulics" will be the best book for practical irrigationists and hydraulicians which has ever been published; it is intended for practical men who have no special theoretical training.

The Reclamation Sentiment Is Growing

Elsewhere in this issue, under the caption of "A Campaign of Instruction," appears an article giving information about a strong movement taking place of arousing interest, in the lower Mississippi valley, in the direction of reclaiming swamp lands. This specific movement is under the auspices of the Illinois Central railway, although the United States government is also interested, the Reclamation "Special" of the railway being fitted up with facilities for lectures, which are given by officials of the United States Reclamation Service and are free.

It is the intention of the management to distribute a large amount of literature giving full information of the agricultural benefits accruing through the reclamation of the swamp lands of the South.

Much has been done by private enterprise already, but this is no more than a drop in the bucket and there are many drainage problems along the Mississippi of such magnitude that it requires the assistance of state and national governments for their proper solution. There cannot be much doubt that it will pay the government to undertake these problems, as the drainage feature is a less difficult one to accomplish than many of the irrigation projects which have been successfully completed and there is no one who doubts if the government once takes hold of it that it will carry it through successfully. This has been shown to be a fact in many and in great undertakings.

Water Waste Is Expensive

It is claimed by some authorities whose judgment commands respect that there are now within the boundaries of the irrigated West about 700,000 acres of irrigated land that has become almost worthless on account of seepage, or what is really the same thing, by having valuable water wasted until now the whole land has become saturated and useless.

This should prove a valuable lesson to irrigators everywhere as it shows that it is not only necessary to turn the water on to the land, but that good judgment is also required. It points out that as a general proposition land must be protected from too much as well as from too little water. Irrigation provides for the lack of water and drainage for the surplus. Thus the land which has been spoiled by seepage can readily be reclaimed by drainage at a cost per acre which will vary considerably according to circumstances. No general rule can be given for such drainage, as each case must be investigated and treated on its own merits. The thing must, however, be done either by ditches or tiling or both, and if no natural drainage can be had the water will have to be pumped.

It is always well to consider the proposition of irrigating lower lying land when draining upland, in which case the seepage water is being put to good use again. However, the best way is to prevent seepage in the first place; this can be done by having the main irrigation ditch lined with waterproof material, and then apply the water to the land in the proper proportion, just irrigating enough for the crop in question. This will insure good crops and prevent waste of water which may be applied for more land lower down, and will result in general economy of operation.

The time is at hand when more scientific methods must be used in the cultivating, irrigating and draining of land in order to obtain the best results. The wanton waste of water should be avoided, and a popular campaign against it should be inaugurated.

A good deal of the trouble, however, is due to defective

planning of irrigation work, especially those which were financed by private capital. In order to get the water available for irrigating land it was done along lines of least resistance in the earlier days of irrigation enterprises, when capital was scarce and timid and the whole proposition was much in the nature of an experiment. Thus it came that instead of concrete lined conduits or timber lined flumes rough ditches were used for water channels, some of them crossing through gravel or sand banks where a large amount of water was lost in seepage. Then the irrigators taking their water from those ditches naturally would just guess at the size of distributing ditches and their grades, and would get, in the usual order of things, too much water on their land.

This early stage of the development of the irrigation era was, however, necessary for the evolution of the scientific stage, and the early errors of the pioneers point the way for improvements so that we may look confidently into the future to see the art of irrigation reach its pinnacle of success.

The Irrigation Age will spare neither pains nor expense to help along this splendid cause and will do everything in its power to advance the progress in the arts of application of the use of water in its relation to agriculture in its broadest sense.

A Very Useful Device for Leveling and Grading.

Elsewhere in this issue appears an article describing a home-made leveling instrument by which anyone of ordinary intelligence and education is enabled to run a line of levels for the purpose of irrigation or drainage. The frame and method described is not a new invention as a similar apparatus has been in use more than fifty years ago in California, when the discovery of gold and the development of placer mines made the presence of water imperative; and as civil engineers were a scarce article then in the mountains, use was made of the leveling frame described to lay out ditches to bring the water sometimes miles across from some mountain torrent. It was, however, done successfully, even though the frame was occasionally made of hewn logs and the plumb bob consisted of a stone and the string of the bark of some young tree.

There is no doubt in the mind of the editor that a good leveling frame is a very handy tool around the barnyard or houses of the progressive irrigator, as by the intelligent and careful use of the same, the most advantageous arrangement of ditching and their alinement can be determined.

The writer had occasion once while on a surveying expedition to make use of this device, hurriedly constructed, on account of an accident happening to the level; it was necessary to complete a line of levels while there was no opportunity of repairing the engineer's level, and the line of levels was completed by use of this improvised machine. When this line was checked later by an engineer's level it was found to be practically correct, the difference being very small.

There will be another article in the August issue of this paper showing a practical application of the device.

Rain and air and sunshine are all essential for the raising of crops, but we must not forget that it also takes a lot of hard work, of elbow grease, and some precipitation, commonly termed perspiration. It requires efforts of no mean size to win even on an irrigated ranch.

The Vital Point Is no Discrimination.

It was recently reported that Judge Gary, president of the United States Steel Company, is in favor of government control of trusts and corporations, even to the point of vesting the government with power to regulate prices of commodities. Such an extension of power seems a very great innovation, so that it is difficult to make any forecasts of results. It is true that the Interstate Commerce Commission at the present time has practically the power to dictate to the transportation companies at what rates they shall sell their commodity (transportation), and yet in reality it seems to be the function of the commission more to see that no discriminating rates are charged and seeing that all citizens are treated alike. This latter function is one which truly belongs to the government, and which function should have been extended long ago to all other principal commodities and necessities of the people. If, for instance, there had been in existence a commission with power to make the Standard Oil Company sell their oil at uniform prices everywhere they could not have throttled competition by underselling other oil companies to force them out of the field. Likewise the packing trust would not have been able to drive out all competition by underselling local butchers and packers. It seems that this vital principle has been overlooked heretofore when dealing with trusts; and it will be wise to extend the powers of the Interstate Commerce Commission so as to give it authority to regulate the prices of the principal commodities, first, by seeing that no discrimination is practiced and that the cost of necessaries of life be determined by adding to the exact cost of production a reasonable amount of profit. The principle of justice should rule in all transactions of the government with the people.

Chips from the Thinking Cap of the Editor.

Watch your neighbor and see how he is doing things; observe results, and if his methods prove more effective than yours be wise and adopt his style.

A farmer should consider himself a business man and as such it is essential that he adopt a system of accounting—no matter how simple, but his account book should show every dollar taken in and every dollar expended. Just try it once and it will prove a great aid to prosperity.

Even nature declines to give something for nothing; the man who thinks he can raise crop after crop from his land without restoring to it the substance each crop takes out of the ground will soon find that he is mistaken and will learn his lesson by sad experience.

* * *

The "Primer of Irrigation" is just the book for the twentieth century farmer everywhere. It covers modern methods of soil culture and irrigation fully and should be in the hands of every progressive man interested in getting his money's worth from the soil.

* * *

Every irrigationist should read The Irrigation Age, which for more than a score of years has catered to his interest and is still in the vanguard. Any subject relating to irrigation, drainage, reclamation and kindred subjects is fully treated in each issue of The Irrigation Age.

* * *

The most successful business man nowadays is the farmer, especially the one whose land is irrigated; he don't even have to worry about the weather.

Geology and Water Resources of the San Luis Valley, Colorado*

By C. E. Siebenthal

Stretching northeastward across the valley from Antonito to Fort Garland is a series of basaltic hills, flat topped and higher west of the Rio Grande, lower and more rounded east of the river, degenerating into a lava-capped mesa, the north border of which forms an escarpment along the south side of Trinchera Creek. At a point 5 miles southwest of Fort Garland this escarpment swings south, joining the San Pedro Mesa at San Luis. These hills and mesas form the southeast limit of the artesian basin, the sand and clay beds of which abut against the older formation, numerous springs coming up along the contact, particularly in the lower course of Conejos River. This contact in all probability marks a fault scarp, the older strata forming the west ranges and the floor of the valley being deeply downthrown to the northwest in the formation of the depression in which the sands and clays of the artesian system were deposited.

In the San Luis Valley there may be distinguished two classes of more or less unconsolidated gravels, sands, and older series of conglomerates with intercalated lava flows, and a younger overlying series of blue clays with interstratified sand beds.

The older conglomeratic series makes up the small isolated mesas and the higher foothills about Fort Garland and southward along the western base of the Culebra Range, as well as the basalt-covered San Pedro Mesa and its northward continuation which has been mentioned in the discussion of the San Luis Hills. Hayden describes these mesas and refers them to the Santa Fe formation. A thin section of some of the consolidated sands from beneath the lava in the north end of the San Pedro Mesa near San Luis shows, microscopically, a prominent calcareous cement. The sand itself is in part volcanic debris and in part of aqueous origin. The age of the Santa Fe formation has been shown by Cope from well-known and characteristic vertebrate remains to be Miocene. The mesas east and south of Fort Garland are capped by a flow of basalt, while sheets of the same rock are interbedded with the gravels and sands of which the mesas are composed.

A series of deposits northwest of Fort Garland, the "compact drift" of Endlich, deserves notice. A great alluvial fan that formed on the left fork of Ute Creek has been trenched by the creek and shows a succession of terraces. Northwest of Fort Garland a mesa approximately 150 feet high is apparently a portion of this fan, which, with others formed by the other streams that converge at Fort Garland, filled up the angle of the valley between the Blanca group on the northwest and the basalt-capped mesa southeast of Garland. The mesa is covered with a sheet of gravel ranging from pebbles up to bowlders 12 inches in diameter, and is made up of fine buff sand or unindurated sandstone, with here and there a gravel layer consisting of various kinds of crystalline rocks, the whole dipping 10° to 12°E. In the next mesa due west, up the draw, the dip of the solt sandstone is somewhat steeper, ranging from 12° to 22° in a direction north of east. Some of the sandstone beds are quite indurated. No fossils are to be observed. The dip continues on across the mesa for a mile, but shifts to the south. Toward the west edge of the mesa the high points are composed of igneous rocks projecting through the sands. Within 200 yards of the igneous rock the sandstone becomes more and more bowldery, until in the immediate neighborhood of the igneous rock it is composed almost exclusively of bowlders and all stratification is lost. The igneous rock has not been intruded into the sandstone, for the contact is everywhere such as would result from the deposition of the sandstone upon a surface that had been subject to subaerial weathering. Distinguishing these beds from Tertiary lake beds under the appellation "compact drift," Endlich correlated them with the valley glacial drift of the Sangre de Cristo Range, though believing them to belong to an early stage of the glaciation. Hayden referred them to the Santa Fe formation, and the present writer coincides in that correlation.

Another occurrence of the older material is in the great sand dunes west of Mosca Pass. Endlich regarded the dunes as of recent origin and derived from the drifting sands of the valley, but Hayden referred them to the Santa Fe formation.

No fossil remains are known to have been found in the Santa Fe formation within the limits of the San Luis Valley, its age determination depending upon localities farther south in the Rio Grande valley.

Though it is impossible to correlate well sections that are any great distance apart, or to trace any stratum of clay or sand from point to point, nevertheless the experience of drillers is that the "first flow" (and by inference, the successive lower flows) in any neighborhood is found at very near the same horizon or depth, gradually increasing in depth toward the center of the valley. For instance, the first flow in the region of Monte Vista is at about 100 feet, near Parma 175 feet, and at Alamosa about 250 feet. Between Center and Hooper the first blue clay is struck at about 80 feet along the entire distance. At Center the first flow, a very small one, is found at 155 feet, at Garnett the first flow is at about 175 feet, and at Hooper and Mosca at about 200 feet. That the uppermost water-bearing bed is covered by a stratum of clay persisting from the center of the valley to the receiving area in the gravelly alluvial slope at the edge of the valley is likewise indicated by the fact that the water is not alkaline. If the bed came to the surface anywhere inside the irrigated area of the valley, it would necessarily absorb more or less alkali from the irrigating waters. Even in the Mosca-Hooper district, where the tinted deeper waters are highly alkaline, the uppermost flow is clear and potable.

The cross section in figure 3, though largely ideal, is based upon all the data available. A fact that comes out in the construction of this section is that wells near the center of the basin show heavy clay beds and fewer aquifers; that wells nearer the margin of the valley, but not too close to it, show thinner clay beds and more aquifers; whereas wells at the limit of the flowing-well area, or outside that line, show but a few and thin beds of clay, with sand largely predominating. This is but an expression of the physical limitation of sedimentation. Sand, being coarser and heavier than clay, would be expected to constitute the bulk of the deposits near shore —that is to say, near the edge of the valley—while the finely divided clays would make up the greater volume of the formation in the center of the valley. Beds of sand, thinning toward the center of the valley, pinch out before reaching that region, and beds of clay thin out before reaching the margin of the basin. Thus the region where both clay and sand beds exist in greatest number is a band of indefinite width which circles the basin some distance inside the margin of the flowing-well area. These features are shown in the diagram (Fig. 4). If it be argued that the lower aquifers, having the heaviest pressure, must be confined by clay beds which extent farther up the alluvial slope in the region of intake, it should be remembered that the pressure where the wells are numerous is dependent largely on their number. The deeper the aquifers the fewer are the wells that reach them. Of two aquifers drawing from a common bed of sand in the marginal region, and divided by a clay septum only part way back from the wells, and hence theoretically with identical pressures, the lower one will nevertheless exhibit the higher pressure if the upper one is more drawn upon by wells.

Attention has been called to the great development of alluvial fans and slopes about the sides of the valley. The great Rio Grande fan occupies a fourth or more of the whole extent of the valley bottom. From the figures which have been given of the depth to the first flow at various points on this fan it is evident that the configuration of the uppermost aquifer agrees closely with the surface of the fan, at least within the limits of the artesian basin. The formation of the fan up to the horizon of the upper water-bearing sand must therefore have gone

*Abstract from Water Supply paper 240 of the United States Geological Survey.

on step for step with the deposition of the Alamosa formation. In other words, the flat alluvial fan of the Rio Grande, with the exception of the gravel veneer, is of sublacustrine deposition, and the fans of the other streams on the west side of the valley are largely of the same origin. The persistency and continuity of the thin beds of sand and clay making up the Alamosa formation show that this deposition was in the quiet water of the lake at some distance from the mouths of the streams. Near the stream mouths the sedimentation would naturally take on the shifting character of delta formation. If sediments of this character occur in the Alamosa formation, they are to be expected in the highest part of the fans and on the border of the artesian basin.

Though it does not exhibit the close relation of topography and structure shown by the Rio Grande fan, the alluvial slope along the west base of the Sierra Blanca is nevertheless shown, by the occurrence of artesian water well up the slope, to be made up of the alternating clays and sands of the Alamosa formation. Aside from a certain lack of correspondence, as shown by the topographic map, between the topography and the limit of the flowing-well area, there is no apparent reason for distinguishing between the age of the fans and that of deposits of the valley proper. The deposit of gravel that veneers the upper portion of the alluvial fans and slopes is probably more recent than the body of the fans. The section (Fig. 3) and the diagram (Fig. 4) illustrate how the glacial moraines of the Blanca Mountains are superposed upon the crests of the fans, which are thus plainly shown to antedate the ice period. The moraine of Zapato Creek is especially well calculated to bring out this relation, because, as explained on a previous page, almost all the postglacial erosion of Zapato Creek has been limited to the north edge of the fan, leaving the front of the moraine surmounting the alluvial fan, practically as it was disposed by the advancing ice tongue.

Sand Dunes.

Incipient dunes occur all over the valley, gathering behind clumps of brush, fence rows, or whatever else offers a wind-break. A particularly sandy area with many small dunes lies south of the Rio Grande between Alamosa and Parma station. Another area lies between Alamosa and Mosca, extending northeastward in the direction of San Luis Lake. The trough of the valley from the railway near Washington Springs northward to Dune station is one succession of small brush-crowned hillocks with interspersed bare places. The latter in the wet season become the sites of ponds and lakelets. Each small lake has an embankment on the north and east shores as a result of the lodgment in the vegetation there of sand picked up by the prevailing southwest wind in its clear sweep across the dry bed and shores of the lake. The San Luis Lakes have such embankments 20 feet high and the Russell Lakes have them in proportion. The alluvial slope at the west base of the Sangre de Cristo Range has much drifting sand and many incipient dunes scattered from Zapato Creek as far north as San Isabel Creek.

The great development of sand dunes, however, is between Medano and Sand creeks, where an area of over 40 square miles is a solid expanse of dunes, some of which reach great size, almost small hills. These dunes consist of rather coarse white quartzitic sand with which is mixed a varying proportion of darker and heavier sand, the latter consisting largely of magnetite, with presumably a proportion of those rare earths ordinarily found in black sands. Several attempts have been made at placer mining in the area but are reported as having been given over on account of the difficulty in bringing water to the deposits. Assays are reported to have shown the darker sands to be high in auriferous magnetite. Be that as it may, it seems undeniable that the sands of the dune area contain a larger proportion of the heavier material than the sand of the valley.

Hayden, as noted, classed the dunes as a remnant of the Santa Fe formation. Endlich advanced the theory that the sand came across the valley from the mountains on the southwest, being driven to its present locality by the prevailing southwest winds, and that it was especially collected in the reentrant angle in the mountain front near Mosca Pass as an effect of eddying currents in the winds, caused by the low gaps in the mountains near this point.

That the sands of the valley are shifting northeastward under the influence of the winds is shown by the long sandy area along the western alluvial slope of the Sangre de Cristo Range and by the embankments of sand on the north and east shores of the lakes and ponds. That the accumulations of the great dune area are so derived is open to question. It has been pointed out that the sand of the dune area averages much heavier than that of the valley in general. In accumulations under such wind transportation and sorting, the reverse would occur. It seems much more reasonable to conclude with Hayden that there was here a remnant of the Santa Fe formation, without the protection of interbedded or overcapping lavas, which has been broken down by the winds, and its sands, whipped now forward and now backward, possibly augmented by contributions from the valley, have been built up into the dunes we now see.

Alluvial Fans.

It has already been shown that the alluvial fans and slopes were essentially completed in preglacial time and that they are probably Pliocene or early Pleistocene in age. But over their surface is a covering or veneering of gravel which must have been largely increased in glacial time and since.

In the description of the topography of the valley reference was made to low bluffs or terraces, not now adjacent to streams, which were explained as old courses of the streams or their distributaries abandoned in their wanderings over the alluvial fans. These and the configuration of the fan itself seem to have been interpreted by various writers as due to former courses of the Rio Grande. Carpenter alludes to the "ancient course" of the Rio Grande, but does not locate it on the accompanying map. Hinton describes and maps the old course as leaving the present river above Del Norte, skirting the foothills with a due northeast course to the trough of the valley, which it followed southward, uniting with the present course of the Rio Grande near Hansen Bluff. The course northeast from Del Norte, as outlined on the map, corresponds to the north edge of the Rio Grande alluvial fan. Doubtless the Rio Grande or some distributary in times past took the course along the north edge of the fan, just as the river at present occupies a course along the south edge of the fan, and just as it must have occupied all the intervening territory, wandering backward and forward across it. In this way it must have deposited the gravel and sandy covering of the fan, in the fashion which may be seen after a shower where a gully in a steep slope strikes a more level space and the streamlet

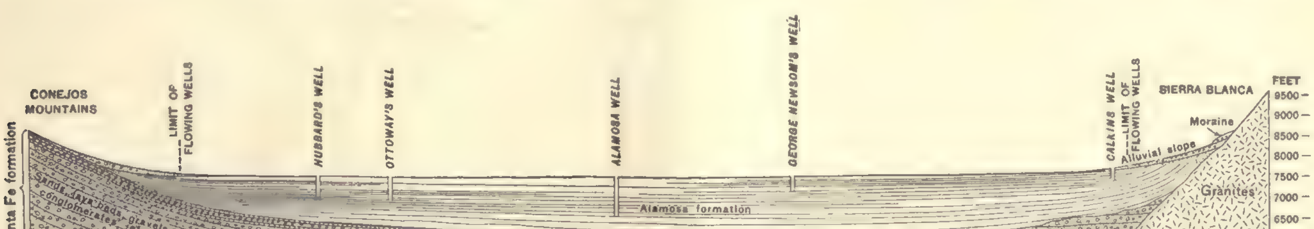


FIGURE 3.—Cross section of San Luis Valley from foot of Blanca Peak to foot of Conejos Range.

drops part of its load and builds up a little alluvial fan. But a wrong impression is conveyed by alluding to it as "the" former course if that is meant to imply that the Rio Grande has had but two courses, that one and the present one.

Endlich outlines a former course of the Rio Grande, leaving the present course of that river 3 miles above Alamosa, circling north of Washington Springs, crossing the railroad near Baldy station, crossing Trinchera Creek south of that station, crossing the Rio Culebra about 6 miles west of San Luis, and rejoining the present course some 15 miles below the New Mexico line. A glance at the topographic map will show the utter improbability of this supposition. Baldy station is 60 feet higher than the point on the river where the old course is supposed to leave and the divide south of Trinchera Creek is 50 feet higher still.

Alluvium.

Alluvial bottoms occur along the Rio Grande and its various tributaries as well as along the other streams which enter the valley but do not reach that river. The width of the alluvium along the Rio Grande varies from 1 to 2 miles, with here and there reaches of gravelly and sandy loam. The habit of the smaller streams to divide into distributaries reuniting again lower down, forming "sloughs" or "bayous," has a tendency to make the alluvial areas of those streams wider than they would otherwise be.

Underground Waters.

The essentials of an artesian system are few and simple:

1. An inclined stratum, as of sand, which receives water in the higher portions and transmits it freely to the lower portions.

2. Relatively impervious layers, as clay or shale or finer sand, which confine the water within the water-bearing bed or aquifer.

3. Resistance to lateral escape of the water from the lower parts of the aquifer greater than its resistance to the ascent of water in the well. This may be due to either of several factors, among the commonest of which are—

(a) The bending up of the beds to form the opposite side of a basin.

(b) The thinning out of the water-bearing sand bed or aquifer.

(c) Loss of porosity in the aquifer.

(d) Frictional resistance to lateral movement within the aquifer itself.

(e) Unconformable depositional contact with less pervious beds, as along lower Conejos River.

The San Luis Valley is an almost ideal example of the artesian basin The structure of the valley has been already discussed, and a cross section of the valley is shown in figure 3. The water occurs in beds of fine blue to gray sand varying from 1 to 20 feet or more in thickness, separated from one another by beds of blue clay ranging from 1 foot to several hundred feet in thickness. In the alluvial slope near the base of the mountains at the margin of the valley the clay beds thin out, the lowest ones usually reaching the farthest and highest up the slope, thus giving the greatest pressure to the flows beneath them, where they are penetrated out in the valley. If all lower openings and avenues of escape in the aquifers were stopped, the water would rise to the level of the receiving area, or, rather, to the lowest point in that area. Thus the water in the strata penetrated at Alamosa would have sufficient head or be under sufficient pressure to rise as high as the margin of the basin about Monte Vista, which would be about 100 feet above the surface at Alamosa. As a matter of fact the head of the Bucher well at Alamosa, the deepest in that vicinity, is not over 56 feet, and the greater number of wells reaching a depth of about 700 feet have a head of less than 40 feet. This loss of head is partly due to the drain upon the water bed by other wells but is probably due chiefly to loss by lateral flow where the sands of the Alamosa formation come into contact with the Santa Fe formation along the northwest margin of the San Luis Hills. In support of this suggestion may be cited the fact that wells near the mouth of Conejos River, in the very lowest portion of the artesian basin, instead of having the very strongest pressure in the valley, as they theoretically should, have on the contrary but small pressures, though very good flows.

The source of supply of the artesin water in the San Luis Valley is unquestionablly the mountain streams which flow down across the alluvial slope. The disappearance of the mountain streams soon after they reach the alluvial slopes is the matter of common observation. This is particularly true of the streams flowing from the Sangre de Cristo Range. Very few of these streams get beyond the piñons which cover the upper part of the alluvial slope. The same is true of the streams on the west side of the valley, though the greater number of the streams there, being much longer and larger than any in the Sangre de Cristo Range, have sufficient volume of water to stand the loss in passing across the alluvial slope and to send a considerable flow to the Rio Grande, especially in the wet season. But all these streams suffer noticable loss in the region of the gravel slope.

The largest stream entering from the west is, of course, the Rio Grande, and along this stream various discharge measurements have been made with a view to showing the loss by seepage of this river in various portions of its course through the valley. As shown by these gagings, the actual loss by seepage of the Rio Grande between Del Norte and Monte Vista, a distance of 15 miles, is 75 second-feet. No other section of the river shows a loss at all comparable to this; in fact, the remainder of its course for the most part shows a gain from seepage. Discharge measurements of various other of the principal streams on the west side of the valley have been made from time to time by the state engineer of Colorado, the results of which show like losses in the region of the alluvial slope.

It has been explained on a previous page that the artesian supply has the first call upon the water of the Rio Grande, inasmuch as one of the large ditches, which has the earliest priority of all ,takes its water from the Rio Grande below the section which supplies water to the artesian basin. Since this priority must be satisfied before any water is taken out above, there will always be water flowing across the area which supplies the artesian basin when there is any water in the river at all. This is largely true of the other streams as well. Therefore the artesian basin will always be supplied with water, and any question of failure of wells in the valley will be one of mutual interference as a result of too great concentration of wells, and not one of expansion of the irrigation systems.

In 1891 Professor Carpenter, estimating 2,000 wells in the valley, with an assumed average flow of 25 gallons per minute, found the total artesian flow to be about 110 second-feet. At 70 acres to the second-foot, this volume of water, if all used, would irrigate 7,700 acres.

Since that year many new deep wells have been bored and older ones sunk to deeper and heavier flows, so that the average flow is now greater than at that time. By actual count, the wells shown on the map and plats herewith number 3,234. The average flow of 1,000 measured and estimated 2 and 3-inch wells, excluding those in towns, amounts to 40 gallons per minute. The wells of the towns have in general much smaller flows than those in the country, but it is believed that the large flows of the wells over 3 inches in diameter, which are not included in the average, will offset the small flows of the town wells, and that the average of 40 gallons is a fair one. Flowing at this average, the 3,234 wells in the valley will yield a volume of water equal to 286 second-feet. At the rate of 70 acres to the second-foot this volume of water will irrigate 20,000 acres. This estimate of the duty of water is probably a minimum. On the average it is perhaps 25 per cent too small, so that 25,000 acres is nearer a true estimate. With adequate storage, this volume of water could be made to irrigate two or three times as great an acreage.

It is practically impossible to estimate the acreage actually irrigated from artesian wells unless a painstaking census be made with tht object in view. Even so, it would be impossible to get accurate figures, inasmuch as many persons use the flow of the wells in connection with the

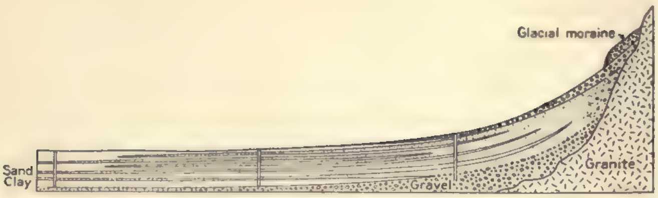


FIGURE 4.—Diagram to illustrate the structure of the artesian basin and the alluvial slope and to indicate the relation of the glacial moraines to the slope.

ditch water. In the absence of such actual figures of acreage irrigated from artesian water, some estimate, such as has been made of the possible irrigation from artesian water, must serve. The only wells not used at all in irrigation, a small percentage of all the wells of the valley, are those used for stock purposes. They are scattered here and there over the untilled land, and the water from them usually sinks within a short distance of the well. The larger wells are almost without exception used for purposes of irrigation. In 1904 there were in the valley 76 6-inch wells, with an average flow of over 300 gallons a minute, and 77 wells over 3 inches and under 6 inches in diameter, with an average flow of about 175 gallons a minute. The total flow of these larger wells was approximately 80 second-feet.

However, the true value of artesian water for irrigation purposes is not to be reckoned by the flat acreage it is capable of irrigating. The special value of artesian water lies in the steady, unfailing supply in times of drought when the ditch water is wanting.

Flowing Wells.

This district includes the wells in the town of Alamosa and those southeastward along the Rio Grande for several miles, as well as those north and east of the town, within a radius of 6 or 7 miles. The district contains some of the largest and most of the deep wells in the valley. Within the town itself, covering 1 square mile, there are 140 wells, the greater number of which are about 700 feet deep or within 50 feet more or less than that depth.

The Bucher well, on the other side of the Rio Grande from Alamosa, but in the northeast corner of the same setcion, is one of the oldest as well as one of the deepest wells in the valley. This well, sunk in 1889, is nearly 1,000 feet deep. The main flow was secured at a depth of 932 feet and the smaller flow at 500 feet, the combined flow in 1891 being reported by Professor Carpenter to be about 600 gallons a minute, or 1⅓ second-feet. The diameter of the well is 6 inches at the bottom. Reduced to 3 inches, it throws a jet of water 48 inches high. The temperature is 74.7°, according to Professor Carpenter, who reports that the pressure indicates a head of 56 feet. No record was kept of the geologic section of the well. The water is without taste, like that of shallower flows. It is caught in a large reservoir and used in a small way for irrigation.

The town well situated in the northwest corner of Alamosa, a mile west of the Bucher well, is 865 feet deep and 6 inches in diameter and is cased to a depth of 852 feet. The flow in 1891, as measured by Professor Carpenter, was 400 gallons a minute. The temperature is 72° F. The water from this well, with additions from the various private wells, is carried in ditches through the streets of the town, irrigating the shade trees and grass plats along the way.

The Denver & Rio Grande well at the water tank is 938 feet deep and 4 inches in diameter at the bottom. It has a flow of 60 gallons a minute at the surface of the ground, or 20 gallons a minute where it empties into the tank at a height of 37 feet above the ground. The pressure, when finished, indicated a head of 46 feet. A small flow was struck at 630 feet, and at 838 feet a flow of 90 gallons a minute, the pressure of which indicated a head of 32 feet. The purpose of going on to the deeper though smaller flow was to get sufficient head to lift the water into the top of the water tank at 37 feet. The flow at 937 feet is the same flow that is struck by the Bucher well. These two are the only wells having this flow in the vicinity of Alamosa, though there are a few other wells deep enough to reach it.

A CAMPAIGN OF INSTRUCTION.

To demonstrate that wet ditches through the swamp land areas of the south and east are of as great economic importance as are the dry ditches created by the government to lead water to arid lands in the irrigated west, the management of the Illinois Central and the Yazoo & Mississippi Valley railroad companies, co-operating with the government, is to operate through the south a train, to be known as the Reclamation Special, carrying lecturers representing the United States Reclamation Service and the Geological Survey, the tour being the initial campaign this year of the Illinois Central to arouse the interest of the south in its reclamation possibilities.

C. J. Blanchard, statistician of the Reclamation Service, and M. C. Leighton, chief hydrographer of the Geological Survey, will accompany officials of the road during the tour. Mr. Blanchard will tell of the work done by the government in the west, while Mr. Leighton will tell the southerners of the agricultural benefits to be derived through the improvement of swamp areas and also of the importance to the national health of such development.

The tour, during which lectures will be delivered at sixty-one towns and cities, has been designed to give impetus to a movement launched recently by the National Irrigation Congress for swamp land improvements. Statistics of the government show there are 80,000,000 acres of such lands capable of drainage and one of the undertakings of the irrigation congress, which meets in Chicago this year, will be to obtain such legislation as will make possible swamp reclamation by the government.

The railway campaign will continue from towns in southern Illinois to the Gulf of Mexico, taking in, besides Illinois, Kentucky, Tennessee, Mississippi, Alabama, Louisiana and Arkansas. Thousands of booklets telling of the reclamation movement as it relates to swamp lands have been prepared and will be distributed by the railway.

The train consists of a baggage car, one coach and a business car. The coach will be employed as a meeting hall by the government lecturers. Two stereopticon outfits will be taken, a smaller one to be used in the coach and the other for bigger halls. Besides many smaller places, the train will reach such points as Cairo, Ill., Memphis, Covington and Jackson, Tenn., Birmingham, Ala., Jackson, Vicksburg and Natchez, Miss., and New Orleans and Baton Rouge, La. A special effort is to be made to interest farmers, merchants and manufacturers and arrangements are to be made for largely attended gatherings at the more important points.

"Reclamation in the south can best be furthered under plans prepared, financed and executed by the government, just as our arid lands in the west were developed," said W. L. Park, vice-president and general manager of the Illinois Central. "Any project to reclaim our vast areas of swamp lands is so tremendous as to seem at first glance almost to be utopian, but such is not the condition at all. Swamp lands are more readily transformed into farms, as the reclamation work constitutes a simpler engineering undertaking than is the placing of water on arid lands. It is easier to lead water away from swamp lands, from an engineering point of view, than it is to reclaim any other lands which for physical reasons are impossible of cultivation.

"I believe that now is the time to become energetic in this work. We have the National Irrigation Congress here to work with and this organization is of much influence in furthering any undertaking of this character. The Irrigation Congress meets Dec. 5 to 9 and at that time it is certain the south will be represented by strong delegates to further the swamp land reclamation movement."

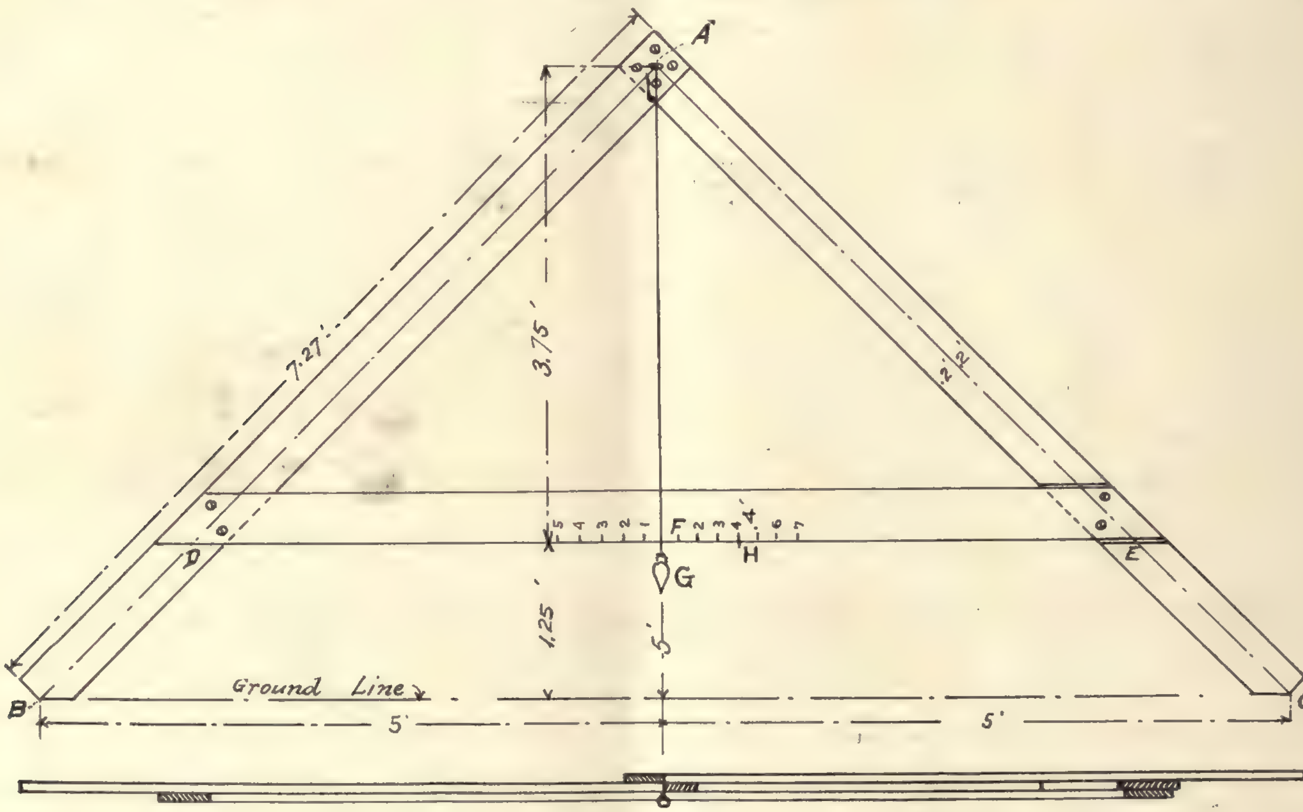
In anticipation of the interest likely to be aroused by the train, officials of the railway have stocked a special department with information concerning swamp lands and from this inquiries for such data will be answered in the future. During the trip of the special persons attending the meetings are to be invited to address the road for information on any subject of swamp land reclamation that has not been made clear.

The Cotton Land & Water Company of Tucson, Arizona, announce that work will begin on the reclamation of 50,000 acres of irrigable land in Mojave valley, California. Concrete channels will be built from the Colorado river and pumping plants will be established.

HOW TO DO YOUR OWN LEVELING.

The proper grade of ditches is a very important consideration in irrigation as well as in drainage; for important and large systems it is best to have such ditches laid out by a leveler under the direction of a competent hydraulic engineer. For small properties involving only a moderate area the owner can hardly afford the services of professional men to lay out his ditches, and this article is designed to help him out to do this work himself quite satisfactorily. The first thing for him to do is to build himself a leveling frame as indicated in the accompanying drawing which is a detail plan showing all necessary dimensions. The lumber used should be preferably seasoned white pine surfaced four sides, about 4 inches wide and about ⅝-inch or ¾-inch thick. The two inclined pieces, A B and A C, are each 7.27 ft. (just a trifle over 7 ft. 3 inches) long, both cut square at A but mitered at the other end as shown in plan, the angle A B C and A C B each being 45 degrees and the angle at A being 90 degrees. The cross piece D E is just 7 ft. 6 in. long from D to E, hence it must be made long enough to reach across the side boards A B and A C; the distance A F must measure just half of this or 3 ft. 9 in.; the center lines should be drawn with pencil as A B and A C and a screw eye fastened into point A, from which should be suspended a plumb bob G by a strong thread A G. The base line will then measure just 10 ft. from B to C and the plumb bob should just clear the lower edge of the board D E; the point A will be just 5 ft. above the ground line. If the frame is made by a carpenter it will be best to mortice the three boards together at A, D and E so that it makes a flush finish, the three surfaces of the triangle lying in the same plane. However, a perfectly satisfactory job can be made by screwing the parts together as indicated in the ground plan of the sketch and inserting a filler block at E which brings the line D E parallel to the base line B C. The graduation should be made on the lower edge of the board D E as indicated.

It stands to reason that, if the contrivance is placed on a level surface, the plumb bob line must cross the line D E in the center F, so the point F is made the zero point. If the frame stands on sloping ground, for instance let point C be higher than point B, then the plumb bob line moves toward D in a certain proportion to the distance that C is higher than B. This proportion is easily determined. The best way to make the graduation is as follows: First, determine the level position on edge D E by setting the frame upon a level surface and marking the position of the plumb bob zero at F; then raise one leg of the frame, say B, until it is just 4 inches higher than point A; then the plumb bob line A G will intersect line D E at a point H between G and E; mark this point 4 inches and divide the distance between F and H into 4 equal parts, each of which represents a difference of level of one inch between B and C. The same thing is done by raising point C 4 inches above B and the graduation is then continued in both directions, with subdivision of ½ or ¼ inches according to the degree of accuracy required. By using the dimensions shown the difference of one inch in elevation between B and C corresponds to a variation of ⅜-inch on the line D E; the graduation should be carefully made by using dividers and should be cut into the board by a keen knife edge and then the line should be filled with ink so that it shows plainly on the board. Also the numbers should show plainly from zero either way although it will not be necessary to name the halves and quarters as they can be readily read off when the instrument is in use and the full inches are marked off. An application and how to make a record of the readings taken and how to plot same and make use of them for practical purposes will be shown in the August issue of IRRIGATION AGE.



What can be done on an irrigated farm, with scientific methods is shown by P. P. Vallery, an old-time rancher of Sonoma near Belle Fourche, S. D. Mr. Vallery has been raising hogs and in the last year has shipped out $1,500 worth, the last shipment being sixty head to a Rapid City packing company, for which he received $9.15, the top price. Other hogs, averaging 250 pounds dressed, and only 8 months old, he killed for his own use. These were fed on macarona wheat and corn of which he had a bumper crop.

PERSONAL.

Mr. E. C. Finney, formerly of the Interior Department, has resigned and announces that he has formed a partnership with Mr. John M. Rankin, with offices in the Maryland building, Washington, D. C. They give special attention to all matters before the Interior Department, but are also prepared to undertake business before any of the executive departments or to contest cases before the local courts or the United States Supreme Court.

UNIQUE PUMPING PLANT TO SUPPLY WATER.

The following interesting description has been taken from the "Payette Independent," Payette, Idaho.

The pumping plant of the Snake River Irrigation company, limited, which is to furnish water for 14,000 acres of fine land just across the Snake river from Payette, is about completed and will be ready to supply water to the land owners during the coming season.

This means the realization of the dreams of the brave, hardy settlers who had the nerve to take up the barren sagebrush land and patiently await the time when some one would provide water to cause it to blossom and bloom. The land is known as the Duncan and Dead Ox flats and lies about two miles from Payette directly across the Snake river on the Oregon side. It is protected by a low rim of hills and is as fine a body of land as a land-hungry homeseeker ever laid eyes on

GENERAL VIEW SHOWING PUMPING STATION.

For many years the land has been homesteaded and the families who have managed to subsist as they complied with the requirements of Uncle Sam in taking up the public domain have displayed great faith in their belief that some day they would be made rich by the coming of water for irrigation.

Their faith has been justified and the spring of 1911 will witness the completion of an irrigation system that will supply water for half of the total area of the flat, and within a short time the system will be extended to cover the entire 14,000 acres. The system is being put in by The Snake River Irrigation Company, Ltd., which has its head office in this city.

There are two unique things in connection with this company and its system. One is that the company has gone ahead and installed its plant, at an expenditure of about $75,000, and not one settler has been asked for a penny or to sign any agreement to buy water stock. The other is the method of generating power for pumping the water.

The company's pumping plant is located on the Oregon bank of the Snake river directly opposite Payette. The water will be lifted 52 feet through a continuous wood stave pipe, 41 inches in diameter and 1,600 feet in length, and emptied into a canal which follows the base of the low hills. It will be lifted by a huge 14-16 double action triplex pump, which weighs 33,000 pounds and will pump 3,500,000 gallons a day.

Power for operating the pump is generated on the principle of a water wheel, but with an equipment very much different from the old-fashioned wheel. The thing is a new patented invention called the "current power transmuter." It is an elongated water wheel; an endless belt of paddles flowing with the current, one-half of which are always immersed in the water, and the other half returning out of the water.

This elongated wheel or endless belt extends down the river 500 feet and is supported on pontoon idlers. The belt is nine feet wide and carries over 200 paddles of the same width and a foot deep. The belt is returned up stream on large spools. By being on pontoon idlers the river may rise or fall and the pumping plant will be affected in no way.

The amount of power obtained is determined by two factors, viz.: the length of the paddle belt and the current. By doubling the number of paddles without changing the velocity of the current the amount of power obtained is doubled, but by increasing the velocity of the current without increasing the number of paddles the power generated increases in a much greater proportion.

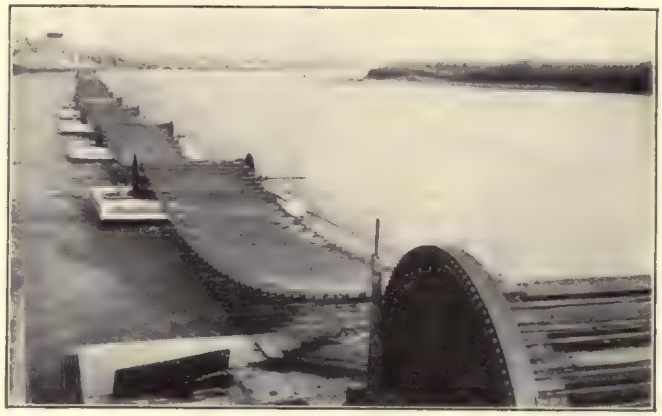
It is figured out that a paddle surface of 24 square feet to the paddle with 57 paddles in the water, in a current flowing six miles per hour, will produce 150 horse power and the same paddle surface flowing 11 miles an hour will produce 1,000 horse power.

The practicability of the current power transmuter has been demonstrated by a plant in operation on the Columbia river in the state of Washington. This plant, which was the first ever built and is of crude construction, develops in a six mile current 120 horse power, or 2½ horse power to each paddle immersed. The plant near Payette is in a seven-mile current and there will be about 100 paddles in the stream constantly

The plant will generate 400 horse power and it will require only 75 horse power to operate the pump now installed, but as soon as there is need of supplying more water than the one pump will furnish, two centrifugal pumps will be installed to raise the water to the 52-foot level and the big pump will be employed in raising the water to a much higher level of between 250 and 300 feet where a large teritory will be reached.

As soon as a large pulley, which has been delayed in shipment, arrives and is installed the plant will be complete and ready for operation. Then a demonstration of its work will be given and the land owners will be given an opportunity to take water stock. It is estimated the cost of water for land under the 52 foot lift will be about $25 an acre and $2.00 a year for maintenance. The water will be ready for use during the coming season.

Since the assurance of an immediate water supply there has been a great deal of activity in real estate on the flat and many of the homesteads are being divided into 80 and 40-acre tracts. New buildings dot the flat on all sides and many owners have cleared their land of sagebrush, and there is promise of a great activity



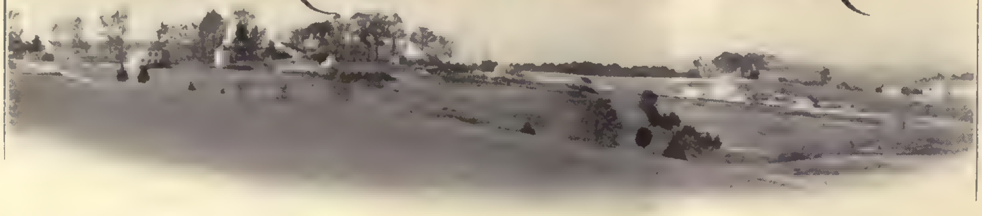
VIEW SHOWING DETAILS OF CURRENT POWER TRANSMUTER.

there when the spring season opens. Scores of families who have been hanging on to their land for several years while they made their living elsewhere will now move on to it and make their homes there.

THE BIG FOUR "30."

The Gas Traction Company of Minneapolis, manufacturer of the Big Four "30" and the first and largest builder of four-cylinder farm tractors in the world, has purchased the Gas Traction Company, Limited, of Winnipeg, and after June 1 the Winnipeg factory and offices will be the Canadian branch of the Minneapolis company. As the only manufacturer of gasoline farm tractors in Canada, the company has unequaled facilities for giving the same prompt and satisfactory service which has been given the farmers of the United States. Engines and stocks of supplies will be kept at various points throughout western Canada. The Big Four "30" is well known throughout western Canada, having won the gold medal and grand sweepstakes in the Agricultural Motor Competition at Winnipeg last year.

ELECTRICITY ON THE FARM



By Henry Farrington, M. Sc. B. Eng. M. R. S. A.

The poet and novelist have given us alluring pen pictures of the old-fashioned plowboy and dairymaid, but the lives of these products of a primitive civilization are not so attractive at close quarters. How much better is it to turn on a bright electric light simply by pushing a button, than to trim and light an oil lamp at the risk of starting a fire! Certainly it is more sanitary to clean the horses and cattle with an electric vacuum apparatus than to scatter the dust and dirt with a currycomb or wash it off with a hose. And it is admittedly quicker and more effective to milk the cows with a vacuum milker, or to clip the horses and shear the sheep by motor-driven devices, than by hand.

The introduction of the tungsten lamp, which gives three times the light for the same current as the carbon-filament incandescent lamp, has placed electric lighting within the reach of every fairly prosperous farmer in the country. And from electric light to electric power service is but a logical step. The rural mail delivery, the telephone and the automobile have brought the farmer into closer touch with civilization, and it is but natural that he should want the benefits of electricity, which in many ways he can use to far greater advantage than the ordinary householder in the city or town.

If an electric power service is possible on a farm, it will go a long way toward solving the problem of the hired man, for the ubiquitous electric motor can be made to do almost any kind of labor. All the smaller machinery can be electrically driven, either by individual motors or by a portable motor outfit. Electrically operated pumps will render the farmer independent of the weather by filling the irrigation ditches or directly spraying the fields or greenhouses. And even plowing by electricity is not only feasible, but nearly 20 per cent cheaper than plowing by horses and about 38 per cent cheaper than steam plowing, as proved by statistics recently compiled by a German authority.

There are several methods by which the farmer can obtain his electricity. If close enough to the power lines of a central station company he can usually buy his current to advantage, and often at a cheaper rate than the city dwellers. The big power companies of the West, who cater especially to the farmer, maintain substations from which the current is supplied at a voltage of from 2,200 to 13,000 (usually 6,600) volts to secondary distribution systems. At the farms there are small transformers which convert this high-tension current to a lower voltage, usually 110, for operating the motors and lamps.

If the farmer is too far away from a power line to buy his current profitably, he can generate it himself. Thus he may harness a small waterfall, erect a wind motor, or use a steam, gas or oil engine.

The water turbine is practical and costs nothing for its "white coal," which is plain ordinary water, otherwise running to waste. It is to be recommended when the water power is available. A splendid example of a water-driven plant is found at Miner's Farm, Chazy, N. Y. This installation has also an auxiliary steam-driven plant for emergency use.

There are many types of waterwheels and water turbines from which to choose turbines alone are classified in several distinct varieties. It is impossible in a short article to consider each type in detail, but there are certain generalities it is well to observe in making a decision of the kind of water motor best suitable for a particular case.

"Overshot" waterwheels, in which the water enters the buckets from the top of the wheel, are suitable for falls of from 12 to 20 feet. The peripheral velocity of the wheel will vary from 3 to 6 feet per second in small wheels, to 10 feet per second in the larger sizes. The buckets or floats should be well ventilated if a high efficiency is desired, a feature of importance in practically all types of water motors.

"White Coal."
The Cleanest Source of Power.

"Breast" waterwheels, in which the water enters about the middle of the wheel, are suitable for smaller falls than the overshot wheel.

"Undershot" waterwheels, in which the water enters the buckets nearly at the bottom of the wheel, are best for the lowest falls, of from 1 to 3 or 4 feet.

For falls above 20 feet in height, there is probably no wheel to compare in both cheapness and efficiency to the Pelton wheel, which depends entirely on the impulse of the water on the buckets, and not upon gravitational action of the water in flowing from a high to a low level.

In all cases, the services of a consulting hydraulic engineer should be be requested before deciding on the type of wheel to employ. The simple waterwheels may even be made by the farmer himself.

The wind motor or windmill is not as a rule favorably regarded in this counutry for generating electricity, although quite a large number of successful wind-operated plants are operating all over the world. Perhaps the best installation in this country is an imported English plant on an estate in Long Island.

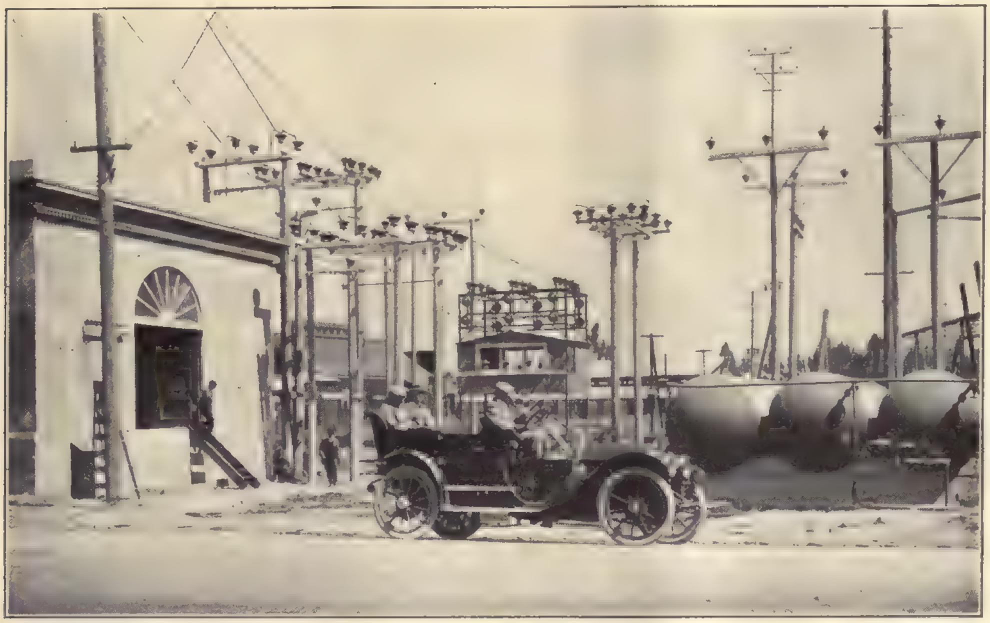
The question of fuel and attendance limits the field of the steam or gas engine, although where natural gas is found, or where a gas producer is feasible, the gas engine may be successfully applied for generating current on the farm.

For small farms, the gasoline or oil engine is perhaps the most practical and economical. It may be used directly or in conjunction with a storage battery.

For instance a 5-kw., 110-volt outfit, giving about 7 hp., will light 200 20-cp. tungsten lamps and drive the motors for operating all the household machines, such as the sewing machine, washer, wringer, fans, etc., as well as supplying current for all the cooking and heating devices, including the electric range, toaster, flatirons, luminous radiators, and the like. The cost of such a generating equipment, including the wiring and lamps, is about $1,060, or including the motors and other apparatus mentioned above, about $2,000. The operating expense would be about $250 a year which is relatively nominal considering the service and the saving in hired help.

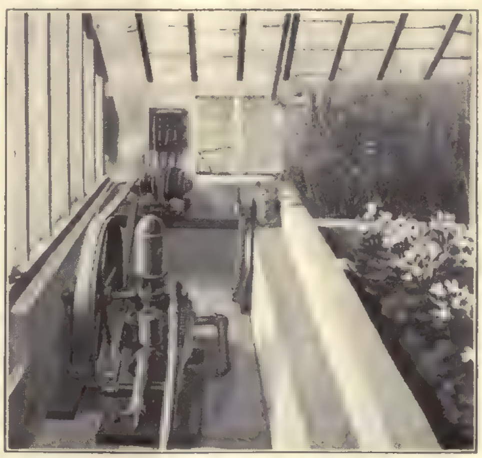
A typical low-voltage lighting outfit, for operating 34 tungsten lamps, of 8 or 16 cp., and including a 1-hp. engine, ½-kw. dynamo and a 16-cell storage battery, would cost about $500. The total operating cost, including gasoline, oil, maintenance and renewals, and interest on the investment, would be less than $75 a year. Such an outfit, however, would not be suitable for operating electrical apparatus designed for a standard voltage of 110 or 220, and 30-volt devices therefore would have to be

Spraying a Field by Electric Power.



A Reinforced Concrete Substation for Supplying Power to Farms in the West. The Oil-Switch House Is in the Center of the Picture.

Milking by Electricity Is Better for the Cow and Produces More Milk Than Hand Methods.



Motor-Driven Pump Used by an Up-to-Date Rochester (N. Y.) Florist for Watering His Plants.

used on the circuit if the current were desired for other than lighting purposes.

For large estates, where the first cost of installation is not considered except in relation to the saving afterwards effected, a comprehensive electrical equipment is profitable, considered as a dividend-producing investment, besides bringing in considerable returns in the way of comfort and absence from worry and care.

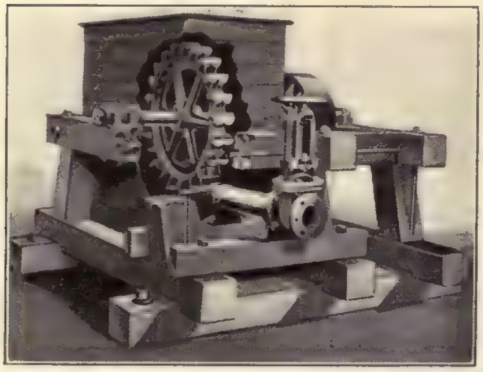
The Virginia estate of Thomas F. Ryan, the well known financier, is a typical example. In the main power-house there is an alternating current generator operated by a producer gas engine, which furnishes the energy of 80 horses—or 500 men—for instant dispatch in any required amount for electric lighting in the house, farm buildings and about the estate generally, and for operating the dairy, driving the farm machinery, working the flour and grist mill, manufacturing ice, and doing the thousand and one other chores about the place.

In the main residence, current is at all times available from the storage battery located in the basement. This is charged from the main power plant, or in case of emergency, from a smaller auxiliary plant some distance away. Not only is the house electrically lighted, but the dish-warmers in the kitchen, heaters in the chambers, and the various cooking devices, are all operated by electricity. Ultimately there will be hardly a task about the Ryan estate that will not be done or materially assisted by this wonderful agent of civilization. A general view of the farm appears above the opening paragraph of this article.

The electric automobile or wagon is a useful adjunct about a farm, and where horses are not regularly used for other purposes, electric vehicles will be found profitable, convenient and speedy. For loading farm products in the field and conveying them to the barn or to market, the electric truck will often be found cheaper than the horse-drawn wagon, and its great capacity and speed in running will greatly economize the time of the drivers. In fact, Germany has gone even a step further in this direction, for in that country there is a farm which has a narrow-gauge electric railway for transportation purposes, and its results are said to be highly satisfactory.

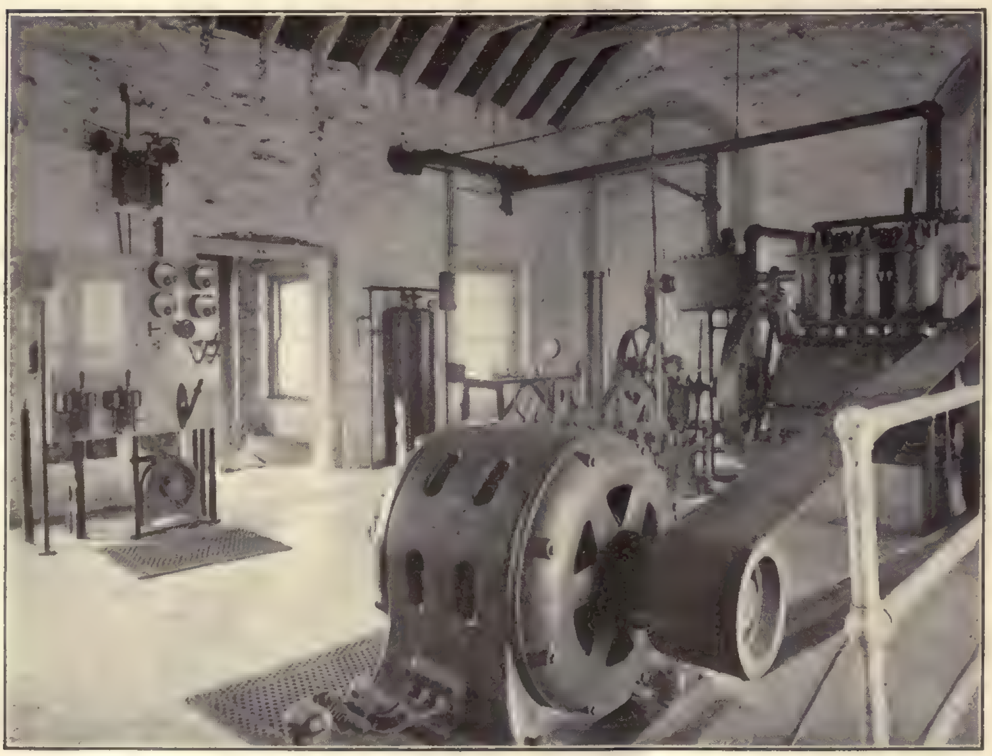
The importance of the problem of irrigation must not be overlooked in a review of this nature, as it is closely associated with the development of electricity on the farm. It it generally admitted that the addition of a hydro-electric plant to an irrigation project adds materially to the value of the undertaking and to the return on the investment as

An English Country Residence Supplied with Electricity by Wind Turbine.



Pelton Wheel Mounted on Wood Frame. An Iron Casing Is More Usual for Electric Work.

Typical Low-Voltage Lighting Outfit for Small Farm—Includes Gas Engine, Dynamo and Storage Battery.



Interior of Main Power Station, Ryan Estate—The Gas Engine Is Operated by Producer Gas.

a whole. Electric motors are ideal for pumping water from low lying irrigation ditches, and, in California, many orange groves and plantations on hillsides are made possible by electric pumping. It has been estimated that an acre of land can be covered with water to a depth of a foot by the expenditure of 2 kw.-hours of current for each foot of lift of the water. The average cost for this power is 10 cents.

With regard to the financial considerations involved, it may be mentioned that the U. S. Government irrigation projects cost approximately $30 per acre of land reclaimed. The value of the irrigated land is on an average about $100 an acre. An alfalfa ranch in the State of Washington cost $600 a few years ago when the land was principally covered with sagebrush. When irrigated, it was sold for $3,000, and, after $1,500 had been put into it in improvements, chiefly electrical, the owner refused an offer of $7,800 for the property.

When this country begins to abandon extensive for intensive farming—that is, when the farms are made to produce their maximum output—electricity will not only be advisable, but indispensable. Then, perhaps, the crop output will be forced by the direct application of high-tension electric discharges from wire "networks" on the fields, as is being done even now in isolated cases in Germany, England and America. And perhaps also the farmer who cannot buy his current cheaply will produce his own alcohol, for operating his engines, from the waste products of his crops.

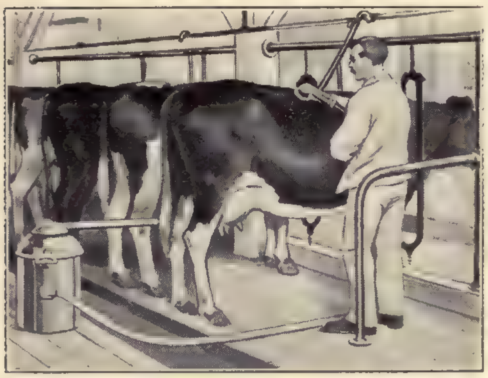
SOME DATA ON IRRIGATION PUMPING.

Stephen O. Jayne, United States irrigation expert, stationed at Spokane, Wash., in a lengthy paper on pumping for irrigation, makes the following observations:

Water power by turbine wheels is first choice.

Electric power, when it can be obtained reasonably, is second choice.

A Western Hydroelectric Power Plant, Showing Pipe Line, Forebay, and Discharge from Impulse Water Turbines.



Cleaning Stall Cattle with Electric Vacuum Cleaner, the Most Sanitary and Efficient Method.

Irrigation Canal Transforms Desert in State of Washington Into Productive Fields and Orchards.

Electricity Furnishes Both Power and Light for Threshing at Night.

WILL AFFECT IRRIGATION

The following notice has been issued by the U. S. War Department:

"Notice of Diversion of Water from the Rio Grande, Texas., for Irrigation Purposes:

"The War Department regards the further diversion of water from the Rio Grande river for irrigation purposes as injuring its navigable capacity, in violation of sections 10 and 12 of the River and Harbor act of March 3, 1899, prescribing 'Laws for the Protection and Preservation of the Navigable Waters of the United States.'

"The construction of any additional works for the diversion of the waters of this river will not for the present be sanctioned.

"By direction of the
"G. P. HOWELL,
Secretary of War.
"Major, Corps of Engineers, U. S. Army.
"U. S. Engineers' Office, Galveston, Texas, March 11, 1911."

The extent to which this order will affect development is problematical, though the issuing thereof is not a surprise. Clearly it will not affect the companies now lifting water from the river, unless said companies should attempt to increase their pumping capacity at the river. The order really makes the old companies stronger, and undoubtedly enhances the value of lands now under irrigation.

Several months ago a special representative of the War Department was in the valley looking into the situation. The river, he said, was by treaty regarded as a navigable stream whose waters must not be diverted; the established bona fide irrigation companies would not be interfered with, but it was plainly indicated that no additional pumps would be allowed in the river.

It is probable the order of the Secretary of War will remain in effect until a new treaty with Mexico is made, permitting the use of the water for irrigation.

FLORIDA MINES MOST PHOSPHATE.

The United States Geological Survey reports that the quantity and value of phosphate mined in Florida in 1909 were somewhat greater than in 1908, although South Carolina and Tennessee the other producing states, made a reduced output. The figures for Florida are: 1908, $8,484,539; 1909, $8,541,301. The total value of phosphate mined in the United States in 1909 was $10,772,120, as against $11,399,124 in 1908. The average price per ton was slightly lower in 1909.

The United States Geological Survey has just published an advance chapter from its report entitled "Mineral resources of the United States, calendar year 1909," on "The production of phosphate rock in 1909," by F. B. Van Horn, which may be obtained free of charge by applying to the Director of the Survey at Washington, D. C.

THE PRIMER OF HYDRAULICS*

By FREDERICK A. SMITH, C. E.

d. Capillary Attraction.

This means if a tube is placed into a fluid which "wets" said tube, there is an attraction between the walls of the tube and the fluid and the latter rises in the former as indicated in Fig. 67. Let AB be a glass tube immersed in a tumbler containing water; then the water rises in AB above the level CD in the tumbler; this rise is proportional to the diameter of the tube and is greater the smaller the diameter is.

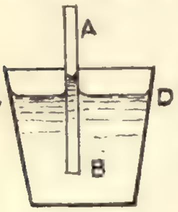


Fig. 67.

This phenomenon of capillary attraction is very important in nature. The growing of plants and trees is accomplished by the fibers and cells drawing their nourishment from the soil and sending it up to the various portions of the plant by virtue of capillary attraction.

Also the fact that a wick draws oil from a retainer up to the flame of the light is due to this fact, the wick acting as a number of capillary tubes. The evaporation of surface moisture in soils is caused by capillary attraction, as the pores in the soil act as capillary tubes and carry the moisture to the surface, when the dry air evaporates the water and the pores in the soil draw up further water. This effect is destroyed by breaking up the surface of the soil (mulching), which destroys the tubular texture of the soil and stops rapid evaporation. This principle is made use of in arid countries and is the principal factor in dry agriculture.

e. Capillary Repulsion.

When a tube is immersed in a fluid which does not "wet" the tube, a repulsion is taken place as indicated in Fig. 68. For instance, let EF be a glass tube immersed in quicksilver, then the height of the quicksilver in the tube will be lower than in the larger vessel, and the fluid is curving away from the walls of the tube and the vessel. The depression depends on the size of the tube and is greater the smaller the diameter of EF.

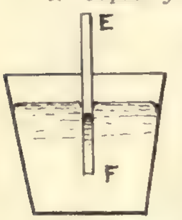


Fig. 68.

f. Buoyancy.

If a block of wood is placed into a vessel containing water it is observed that the block sinks down a certain depth and then remains suspended, which phenomenon is ordinarily termed *swimming* or *floating*. If instead of a block of wood a block of stone is used the stone will sink to the bottom of the vessel; when raising such stone under water it is found, however, that it seems much lighter, and in the act of lifting it from the water it appears to get heavier as it emerges from the fluid. Upon careful investigation it is found that every solid substance immersed in water loses as much weight as the water weighs which is displaced. This principle is called buoyancy, and applies to all fluids. If the weight of the displaced fluid is greater than the weight of the submerged body, as in the case of the block of wood, then body rises to a point so that the weight of the body equals the weight of the displaced fluid, and the body is then said to be floating. If the weight of the displaced fluid, however, is less than the weight of the immersed body, then the body will sink to the bottom of the vessel although its weight has been diminished equal to the weight of the displaced fluid.

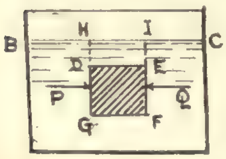


Fig. 69.

The principle involved is illustrated in Fig. 69, in which the vessel contains water to the line BC; if a block $DEFG$ is immersed, then according to the law of pressures in fluids the pressure on top of the face DE *is* equal to the weight of the water column $DEHI$; the pressure on the bottom face is equal to the weight of the water column $GFHI$, hence the upward pressure on the face GF *is greater than the downward pressure on* DE by the difference $GFHI - DEHI = DEGF$, which is the weight of the displaced water. The side pressures P and Q are equal and opposite so they balance each other. The upward pressure, then, will, if it is greater than the weight of the block $DEFG$, lift the block until the upper part of it rises just high enough above the surface of the water so that the displaced water weighs exactly as much as the block; then the upward pressure equals the weight of the block and the downward pressure of the weight of the block equals the upward pressure of the water which produces equilibrium and the body floats.

If the weight of the block $DEFG$ is, however, greater than the displaced water the force of gravity overcomes the upward pressure of the water and the body sinks to the bottom although with its weight diminished to the amount of the weight of the displaced water.

If instead of water other fluids are considered, the only difference there is is due to the density of the fluid, *i. e.*, the relative weight of the fluid compared with water. Thus if instead of water quicksilver is used, which is 13½ times as heavy as water, the buoyancy effect will be much greater, and a solid block of steel, which quickly falls to the bottom of a vessel filled with water, will float on quicksilver; on the other hand a block of wood floating on water will sink to the bottom of a vessel containing oil or alcohol.

g. Specific Gravity.

Different substances have different weights per cubic inch or cubic foot. A cubic ft. of water weighs 62.4245 lbs. at its greatest density of 39.1° F.; from this temperature it expands as it gets colder or warmer; at freezing point 32° F. 1 cubic ft. of water weighs 62.42 lbs., and at the boiling point, 212° F., it weighs 59.76 lbs.; at 60° F. it weighs 62.37 lbs., which is a good average for perfectly pure water. The water we have to deal with, however, is seldom chemically pure, but contains other substances in solution which tend to make it heavier, and for this reason 62.4 lbs. is much nearer the average weight of a cubic ft. of water.

By specific gravity of any substance is meant a figure which indicates the ratio of the weight of a unit volume of that substance compared to the same unit volume of pure water. Thus the specific gravity of quicksilver is 13.5; this means that one cubic inch of quicksilver weighs 13.5 times as much as a cubic inch of pure water.

To find the specific gravity of any substance, first weigh the substance in air; let its weight in air equal W; next weigh the substance in water and let the observed weight equal w; let S equal the specific gravity sought, then:

$$S = \frac{W}{W - w}$$

To illustrate: It is required to find the specific gravity of a piece of ore; it is first weighed in air, and assume its weight is 12 ounces; next the same piece of ore is weighed under water, and we will assume its weight then is 10 ounces; then according to above formula find S by substituting the observed values:

$$S = \frac{12}{12 - 10} = \frac{12}{2} = 6$$

which gives 6 as the specific gravity of the substance in question.

This principle is very important and one easily applied. A table of specific gravities of the more important substances appears elsewhere in this book.

h. Compressibility of Water.

The common impression is that water is not compressible; it is, however, slightly so, the coefficient being .000003 per lb. pressure per square inch, so that it would take a pressure of a million pounds per square inch to reduce its volume 3/10. So for all practical purposes it may be said water is incompressible.

How little this compressibility of water does amount to may be inferred from this fact, that even at a depth of a mile in the ocean, where the pressure is something enormous, 5,280 × 625 = 333,000 lbs. per square foot, or nearly 2,292 lbs. per square inch, yet the weight of a cubic foot of water is only half a pound more than it is on the surface.

Hence it is perfectly permissible to ignore the compressibility of water.

Supreme Court Decisions

Irrigation Cases

RIGHTS OF PRIOR APPROPTIATOR.

A prior appropriator may change his point of diversion so long as it does not prejudicially affect the right of any subsequent appropriator. *Carlson* v. *City of Helena.* Supreme Court of Montana. 114 Pacific 110.

RIPARIAN OWNERS.

A riparian owner could irrigate his land through a ditch tapping the stream on adjoining land by the consent of the owner thereof, taking the water from the stream at a point outside of his own land. *Redwater Land & Canal Co.* v. *Jones.* Supreme Court of South Dakota. 130 Northwestern 85.

SURFACE WATER.

While an upper landowner is entitled to have his surface water discharged upon adjacent lower land according to its natural flow, he cannot change the natural manner of discharge by conducting the water by new channels in greater quantities onto the lower lands, thereby increasing the burden of the servient owner. *Peck* v. *Peterson.* District Court of Appeal, First District, California. 115 Pacific 327.

RIPARIAN RIGHTS.

That another landowner permitted defendant to construct a ditch across his land to a stream because he believed that defendant as riparian owner could condemn a right of way over his land for taking water would not prevent defendant from subsequently acquiring the right to maintain the ditch over such land by prescription. *Logan* v. *Guichard.* Supreme Court of California. 114 Pacific 989.

APPROPRIATION.

A party who does not show that the quantity of water to which he is entitled by a judgment does not reach the head of his ditch, whenever he has occasion to use it, may not complain of the judgment awarding a quantity of water to another for use, to return to the stream above the head of the party's ditch. *Featherman* v. *Hennessey.* Supreme Court of Montana. 113 Pacific 751.

TENANT'S DUTY TO PREVENT DAMAGES.

Where a landlord, renting on shares, agreed to construct an irrigation lateral, he was not liable in damages to the tenant for failure to construct such lateral where the tenant could have prevented the injury at a little expense and failed to do so, though the landlord knew of the defects and had an opportunity to repair the same. *Poutra* v. *Martin.* Court of Civil Appeals of Texas. 135 Southwestern 725.

IRRIGATION CUSTOM.

Where the irrigator contracts with an irrigation company for water knowing that it was furnished under a pumping system, any custom among the users of a natural flow of waters would not apply to prevent the irrigation company from making reasonable regulations as to the time and amount of the flow, provided the amount contracted for was furnished as the circumstances required. *Shafford* v. *White Bluffs Land & Irrigaion Co.* Supreme Court of Washington. 114 Pacific 883.

PREFERENCE TO DOMESTIC PURPOSES.

Under the provisions of section 3, art. 15, of the Constitution of this state, "the right to divert and appropriate the unappropriated waters of any natural stream to beneficial uses shall never be denied. Priority of appropriation shall give the better right as between those using water; but when the waters of any natural stream are not sufficient for the service of all those desiring the use of the same, those using the water for domestic purposes shall (subject to such limitations as may be prescribed by law) have the preference over those claiming for any other purpose." *Montpelier Milling Co.* v. *City of Montpelier.* Supreme Court of Idaho. 113 Pacific 741.

APPLICATION FOR PERMIT.

Water Code (Laws 1909, p. 332) § 45, requires one intending to acquire a right to the beneficial use of any water before commencing construction of a ditch to apply to the state engineer for permission to make the appropriation, and section 46 requires such application to give the legal subdivisions of the land to be irrigated. Section 58 provides that all applications for reservoir permits shall be subject to provisions of sections 45 to 51, inclusive, except that an enumeration of any land proposed to be irrigated shall not be required in the primary permit, but the parties proposing to apply for the beneficial use of the water stored in any reservoir shall file an application for a secondary permit in compliance with sections 45 to 51, inclusive. *Held,* that an application for permit to make an appropriation of certain of the water of P. river was for a permit to use the public waters of the state, though it also asked for a permit to construct a storage reservoir, and was made under sections 45 and 46 as well as under section 58, so that it should give the legal subdivisions of the land to be irrigated, as required by section 46. *Cookinham* v. *Lewis.* Supreme Court of Oregon. 115 Pacific 342.

IRRIGATION—DAM—

Defendant operated an irrigation canal constructed by its predecessor, which also owned certain agricultural lands, which were sold to purchasers with a perpetual right to the use of water for irrigation purposes up to a definite quantity, but the defendant was not to be responsible for any deficiency caused by the act of God, etc., and could sell water equivalent to the carrying capacity of the canal during the irrigation season, and, in case of shortage, each water right to suffer proportionately. Defendant put in a new dam that impounded the water that had previously gone to waste, and installed a new water wheel for lighting a town with electricity. *Held,* that plaintiff, in an action for failure to supply him with sufficient water, was entitled to recover, although there was a dry season, when the evidence showed that there would have been sufficient water but for the installation of the new wheel. *Evans* v. *Prosser Falls Land & Power Co.* Supreme Court of Washington. 113 Pacific 271.

CONDEMNATION OF WATER RIGHT.

In proceedings by a town to condemn a water right, all the facts as to the condition of the land and its surroundings, its improvements and capabilities, including the productive character of fruit trees, the character of the soil, and the amount of water supplied to the land by an irrigation ditch, are admissible in determining the injury to the land resulting from the appropriation.—*Benninghoff* v. *Town of Palisade.* Supreme Court of Colorado. 108 Pacific 983.

APPROPRIATIONS FOR THE WORK OF THE UNITED STATES GEOLOGICAL SURVEY.

Most of the appropriations for the work of the United States Geological Survey are included in the great government supply bill known as "An act making appropriations for sundry civil expenses of the government," popularly called the "sundry civil bill." The bill for the fiscal year closing June 30, 1912, contains appropriations for survey work amountinging to $1,205,520. The principal items are is follows:

Topographic surveys	$350,000
Geologic surveys	300,000
Mineral resources of the United States	75,000
Chemical and physical researches	40,000
Geological maps of the United States	110,000
Gaging streams, etc	150,000
Surveying national forests	75,000

The bill also appropriates $165,000 for printing and binding survey reports, to be expended by the Public Printer.

In addition to these amounts the sum of $100,000 for surveys in Alaska was included in the urgent deficiency act, approved December 23, 1910, and the sum of $37,400 for rents was appropriated in the "legislative bill," making a grand total of about one and a half million dollars.

J. P. Newell, colonist agent for the Hardscrabble irrigation district, has taken several automobile parties from Canyon City out to Mountain View Park to inspect the land soon to be brought under cultivation in that portion of the country.

* * *

Four irrigation projects filed papers with the county clerk in Pueblo in a period of twenty-four hours. All of the projects are to be located in Pueblo county, and will mean the expenditure of about $75,000.

CORRESPONDENCE

FROM OUR ANTIPODES.

American Consulate, Sydney, Australia, April 27, 1911.
EDITOR IRRIGATION AGE:

Before leaving Los Angeles last September I wrote you of my intended journey.

Since arriving here I met a Mr. McIntosh, Director of Immigration for the South Australian government, and as he leaves here today via Egypt, Italy, London, New York, then Chicago, I have given Mr. McIntosh a letter of introduction to you. His visit is to look over the United States reclamation projects and report on same to his government.

Mr. McIntosh asked me the best place to have all his mail directed to reach him in Chicago and I suggested in your care. I told him I would write you in reference to keeping his mail until his arrival.

Mr. McIntosh has been a subscriber of THE IRRIGATION AGE for a number of years and he told me the advertisement on the cover page of the Austin Dredge Machines, Irrigation Ditch Cutters, etc., so appealed to him that he wrote for booklets, etc., and the first thing he did when he took his present position was to order a machine I think he said cost $7,000 for his government. It may be of interest to the Austin people to know just where they are getting results from. I would suggest you taking Mr. McIntosh to the Austin offices personally.

Mr. McIntosh's London address is care Agent General for South Australia, 85 Grace Church street, London, England. You will get this letter in sufficient time to write Mr. McIntosh a note that you are looking forward to his coming and that you will hold all mail for him. This will no doubt please him and also feel the welcome for which Americans are noted. I am sure you will enjoy meeting Mr. McIntosh, even from a personal side.

Mr. Perkins of the Reclamation Service is a man that he will greatly appreciate meeting, and if you will take him personally to Mr. Perkins I will appreciate it. He knows Mr. Elwood Mead. Very soon I will be in Melbourne, Victoria, and I will get after Mr. Mead, as I understand the state of Victoria is about ready to do a little publicity to also reach the American farmer. There is some business to be had here and I am going to look after it.

I have succeeded in getting the South Australian government to adopt the Neal Cure for the Drink Habit, for which I have a lease on the whole of Australia and New Zealand. I am pushing this along and I intend to do a little newspaper work on the side.

Always address me as above as it is my permanent address and all mail is forwarded. I am at present in Adelaide, which is 1,100 miles from Sydney. I expect to go to Sydney within two months and return here about the time Mr. McIntosh returns. Very truly yours,

ARTHUR HOLLIDAY.

FLOW OF ONE-EIGHTIETH CUBIC FOOT PER SECOND.

July 1st, 1911.

Editor IRRIGATION AGE:

In your June issue I notice a communication from E. L. Mattoon, of Stamford, Texas, regarding a flow of one-eighth foot per second. I, too, have a contract with a canal company operating in Idaho under the Carey Act, but my contract calls for one-eightieth instead of one-eight cubic foot per acre per second of time; which reconed from a continual flow during the season would be about three-fourths (¾) acre foot per month. Interested Subscriber.

This flow, ¾ cubic foot of water per minute, or 45 cubic feet per hour, or 1,080 cubic feet per day of 24 hours, or 32,400 cubic feet per month of 30 days, checks interested subscribers' figures above. This is plenty of water for the average crop.—Editor.

Carloads of laborers are leaving the larger cities of Colorado to work on the Denver Reservoir & Irrigation Company project and it is estimated that within a few days 1,500 men will be employed.

ABOUT THE BANKING QUESTION.

TO THE EDITOR:

Following the publication of a letter signed by me in THE IRRIGATION AGE for May, preliminary steps have been taken toward an organized movement in protection of Western interests against abuse by Wall street and its banking power. The article attracted wide attention and aroused much feeling, for it disclosed the conspiracy by which early last year projects for reclaiming and improving Western lands were suddenly jolted to a standstill. I need not repeat the statements therein made, but they drew out an expression from many states, favoring such a movement as the one proposed. No relief from the present and dangerous condition seems to be possible in any other way, so the people must organize to protect themselves. They can do it, effectively.

The whole attitude of the banks for more than a year has been hostile to all Western interests. Not only land improvement has been stopped, but every man not possessed of great wealth has been directly or indirectly injured. We propose now to create an organization that shall include the farmers, the small business men, the labor unions, and all those who are in sympathy with the interests of the great majority of our citizenship.

We propose to ask the farmers to deposit no money with their banks until this wrong is righted. If the country banks desire to carry accounts with city banks, let them do it with their own money, and not with the money of the farmers, the smaller merchant, nor the people who get salaries or wages. In the present circumstances such balances are made up from funds deposited by such people as those just named, and find their way through the organized channels of banking business (so called) into the banks of New York, where the city banks carry their balances, and goes directly into Wall street, for the purpose of speculation on the stock exchange.

This statement is true as a matter of solemn fact, and should be known and corrected by the people who furnish the money. The whole process is an outrage upon the real producers of the wealth of the country, and has been in operation far too long.

The power of New York and the banking interests has gone so far beyond the law that bank inspectors, federal and state, acting on orders, have thrown out of the banks all land securities of whatever nature found in the vaults, with the exception of mortgages on city real estate at low interest rates. It is proper and necessary that the people find out where the authority for this arbitrary and wholly unjustifiable course by the bank inspectors originated, and having found that out, it is their special duty as a matter of self defense and of protection to their families, to have the offenders brought to justice. What is everybody's business is nobody's business, when it becomes necessary to take public corrective or protective action. This can be done only through an organization such as we propose, and we ask you not only to join it for your own sake, but for the sake of your country and your children—to assist in bringing about local banking associations, which in turn can create and perfect a central organization, all working together to the same end and for a common interest.

One of the objects of this organization must be to get the government through the attorney general to investigate the banking trust. We want an organization strong enough and sufficiently wide spread to force upon the government the necessity for action against this criminal business, and to put the criminals themselves behind the bars. We want the present banking system done away with altogether. We want to prevent the adoption of the proposed Aldrich system, which would bring about a condition worse than the one existing now, because it would confer upon the bankers, who own less than 5 per cent of the money they handle, means to extend their power, and further enrich themselves, at the expense of the people who have earned all that money and who own it.

We intend through this proposed organization to show the farmers how they are harming themselves by banking their money in their neighborhood towns; the working men how they are handing their enemies a weapon by depositing money in savings banks. We propose to create a banking system that will prevent panics instead of bringing them on. Pending our proposed organization, the United States

Postal Savings bank and the safety deposit vaults are open to all such people who wish to have their money safely cared for, and who should be able to command its uses whenever and for whatever purposes they may see fit.

We will keep out of politics excepting so far as to favor any party making our purposes a part of its platform, and definitely and irrevocably pledging itself to carry those purposes into actual effect.

To get the immediate impetus to this movement we ask you—the individual reading this article—to write us telling us whether or no you will come into it now in its preliminary stage, and help in your own neighborhood, and among your friends, to get it into form and numbers. The time has come when if the West is to save itself from this tyranny it must take action, and the way to get action is to come together. Upon your accession to this enterprise we will notify you of the time and place of the first meeting and will hope to see you there. At that meeting a plan will be clearly formulated and officers appointed who will take care of the work lined out to follow.

Every good citizen should feel it a part of his duty to devote such of his time and thought and energy as he can spare from his occupation to advance the general welfare. There never was a time when this slight sacrifice would mean so much for the salvation of the West from the predatory power of the East, which is not in sympathy with the part of the country which produces the great bulk of the country's wealth from year to year.

J. C. O'Neil.

ENCOURAGING TO THE EDITOR.

Mr. D. H. Anderson, Editor.

Please change my address from 1318 Fifth avenue to 514 Seneca street, Seattle, Wash., and oblige. I like your paper very much and I would not be without it for five times its cost.

W. C. Marburger.

HOW NATURE GROWS TREES.

J. D. Ream, Custer County, Neb.

In the section of Iowa where I lived when a boy, it was the universal custom when preparing the ground for garden vegetables, to throw the soil up in beds or ridges, but when I came to Nebraska in 1878 I was very much surprised to find the farmers growing all kinds of garden vegetables under what is known as the level culture system, and the reason they gave for doing so was that vegetables succeeded much better in dry seasons under that system.

This I found, after several years' experience, to be true. And when I was ready to prepare my ground for my orchard and windbreaks, I concluded that if level culture was best for garden vegetables in central and western Nebraska, it must necessarily be better for tree growing. So I prepared my ground, set my trees and cultivated them with this level culture idea always in view. After I had worked along these lines for ten long years and had the ground in my orchards and windbreaks as level as a floor, I began to study Nature's method of growing trees and grass and weeds.

I found that when she wanted to grow an extra thrifty tree, some tall grass or some large weeds, she was not content to plant them on level ground and give them level culture. She always hunted for a depression in the surface of the ground or a little hollow between two ridges or a favored spot in a canyon. In fact, she always chose a place that received the benefit of more water than fell on it in rain or snow, or at least one so situated that it absorbed all the water that did fall on it.

I then began to observe more closely as to the methods my neighbors were employing in their attempt to grow trees, and I found that nineteen out of every twenty of them had so cultivated their ground after their trees were planted that they had their trees standing on a ridge.

After comparing Nature's method of growing trees with that of my neighbors, I congratulated myself on having gotten half way to the right method. But just then I happened to remember that many a fellow in the past had gotten half way to success and then failed, and the great problem that confronted me was how to retain the advantages of my partial success in the way of level culture, and yet gain the benefits of the lesson I had learned from Nature.

My first move was to plow my orchard both ways with a stirring plow, having the back furrows come in the middle of the spaces between the rows and the dead furrows come at the tree rows. I used a single horse and a boy to finish up the furrows, and as I had set my trees quite deep I succeeded in getting quite a ridge between the rows and the surface of the ground around most of the trees quite a little below level; all trees planted in the orchard since then have been put in low ground.

By careful cultivation with a reversible extension orchard disk throwing the dirt from the trees tword the center of the space between the rows, I have kept the depression around most of the trees so low that it will hold from one to five barrels of water before any of it would run away, thus making something of a reservoir for the surplus water during heavy rains.

I also deserted the level culture system in growing my trees for my windbreaks. I plowed my ground for these trees in lands about sixteen feet wide, having the dead furrow come where I wanted my tree row to stand. Then I dug this dead furrow up as thoroughly as I could with subsoiler and disk. Planted my cedar trees about seven or eight feet apart in the row, using the same methods of cultivation that I used in the orchard to keep the ground ridged up between the rows and the trees in the low ground.

If you do not have a reversible disk, you will find that a good boy, a steady horse and an old-fashioned stirring plow will be a great help in keeping the ridge up and the weeds down. By having the ground sloping gradually from the center of the space between the tree rows in toward these trees the same as I tried to have it in the orchard, all surplus moisture will run toward the trees and all trash and leaves will drift toward the trees rather than from them. The tree that stands upon a ridge exposed to wind and sun can keep neither moisture nor mulch about its roots.

If the rows were sixteen feet apart and the trees close together in the row, there would be a good driveway between the rows, if the grower cared to haul out the limbs that were trimmed off or the extra trees that were thinned out. Besides a mower could be run through to cut down weeds or a crop of alfalfa.

A GOOD CROP OF WATER.

There is general rejoicing among farmers under the government irrigation projects on account of the heavy snow fall at the headwaters of the streams. Many of the storage reservoirs are already nearly filled, thus assuring an ample water supply and abundant crops to the settlers.

The engineer in charge of the Truckee-Carson project, Nevada, reports a series of heavy snow storms in the Sierras which have accumulated the greatest depth of snow on record for this period of the winter season. Cold Springs reservoir on the Umatilla project, Oregon, is already nearly full, and others in the various sections are rapidly nearing maximum capacity. From Phoenix comes the word that the depth of water behind Roosevelt dam is already 157 feet and the water is still rising. The reservoir has not yet had a full season for storage, still it now contains 500,000 acre feet and is more than one-third full. This great lake is now being drawn upon to furnish water for the growing crops of the Salt River Valley.

The Asherton Artesian Land & Irrigation Company of San Antonio, Texas, was recently organized with a capitalization of $600,000. The incorporators are Asherton Richardson, Asher Smith, Littleton Richardson and H. M. Burt.

* * *

Governor Carey, of Wyoming, is doing some good boosting for the National Irrigation Congress, which will hold its nineteenth session in Chicago, December 5th to 9th, of this year.

Governor Carey states that the irrigation congresses have been one of the greatest factors in advancing irrigation investigations, and the promotion of irrigation enterprises. He has been a staunch friend of the irrigation Congress, and with the assistance of Fred J. Kiesel, of Ogden, and one or two others, managed to save the life of that organization when unscrupulous delegates tried to kill it by merging it with the Trans-Mississippi Congress.

Reclamation Notes

CALIFORNIA.

In accordance with the terms of the Bridgeford Act, under which the Oakdale district was organized, bonds to the amount of $1,175,000 were sold recently, the successful bidder being Henry M. McDonald of Los Angeles.

The Sacramento Valley Irrigation Company recently sent several carloads of tents, camp equipments and implements to Delevan, where the big construction work is to be done. This indicates that active work will begin at once and that hundreds of men will be employed in that vicinity.

A contract was let recently by the firm of Smith & Mizener, the owners of the Orchard Dale Rancho subdivision in the Whittier district, for an auxiliary pumping plant which is to be in operation the first part of July. This gives the subdivision one of the most complete as well as dependable water systems in southern California.

Several demonstration farms will be established on the Jacinto and Packer units by the Sacramento Valley Irrigation Company. The work on these farms will involve the seeding of alfalfa and the planting of trees. This work will be in addition to the contracts let for the construction of canals and laterals, requiring the moving of more than 1,000,000 cubic yards of earth.

J. W. Woodward, a director of the South Joaquin irrigation district, was in Stockton recently and announced that the matter of the confirmation of the proceeds in connection with the recent irrigation bonds and their validity is now in the Supreme Court and a decision will be given within sixty days.

The Reclamation Service has completed a mile and a half of the main canal on the California side of the Colorado river near El Centro.

A new irrigation system in Glenn County supplies all the water the farmers can use, with plenty to spare. The new farms under the system are making good and the development of the district is rapid.

The most important irrigation project ever launched in Santa Barbara county, aside from the work of the Union Sugar Company in the Santa Maria valley, is now in a fair way to fulfillment in the Sisquoc region.

That land owners of the Orland district want 25,000 acres irrigated in addition to the 14,000 embraced in the government irrigation project, and whether the government lends aid or not they are going to have that area irrigated, was the substance of a decision reached at a meeting held recently by fifty-nine land owners of that section.

After a series of tests on irrigation problems throughout the state and a complete investigation of the use of underground water at Pomona, the United States Department of Agriculture has issued two bulletins on problems before California ranchers. The bulletins are descriptive of methods used at different points in the state and are being distributed at the department located at the State University, Berkeley, California.

Plans of the Chuckawalla Development Company to irrigate 250,000 acres of mesa land in the Palo Verde have been approved by the Secretary of War and will be carried out under the supervision of Lieut. Charles T. Leeds, United States Engineer for the district. The project contemplated is to take water from the Colorado river on the California side below Parker, Arizona, and raise it with a series of pumping plants more than 300 feet to various levels of the interior many miles to the westward. A special act of Congress was necessary to give the company permission to dam the Colorado river.

The Standish Water Company has a large force of men at work finishing its water system south of Amendee and this large irrigation plant will be in operation shortly.

After a hearing extending over two months, the board of supervisors have fixed the water rates for irrigation at $3 for one cubic foot per second for twenty-four hours. The Yolo Consolidated Water Company is not satisfied with the new rate and it is said the matter will be taken into the courts on the ground that the rate will not allow them 6 per cent on their investment.

COLORADO.

Without a vote in opposition, the Pueblo irrigation project carried. This enterprise means the reclamation of about 50,000 acres of arid land in the southwestern part of Pueblo County at an approximate cost of $2,500,000.

Mr. Fred L. Barrett, manager of the Southwestern Construction Company, was recently in Chicago, where he completed the arrangements for financing the Bent-Prowers irrigation project, which will bring into cultivation 80,000 acres. The district has been bonded for $4,000,000 and is composed of some of the finest land in the lower Arkansas valley, lying south and west of Lamar.

Mr. Morris Bien, chief legal adviser of the Reclamation Service; E. E. Honnald, assistant legal adviser, and Phillip T. Welles, of the Department of the Interior, have arranged with the Water Users Association for bringing into one enterprise the ditch and water systems of the Uncompahgre valley.

An irrigation deal of great importance was consumated recently when the LaJara reservoir, heretofore owned by Anderson, Ord & Swope of Colorado Springs, passed into the possession of the Terrace Irrigation district.

By a district system of drainage and irrigation for the lands southwest of Alamosa, comprising 128,000 acres, the water placed upon the upper portion will be used over at least four times before it finally reaches the Rio Grande river on the extreme eastern edge of the district.

By the purchase of the Divide Canal by the Windsor Reservoir and Canal Company, which is controlled by the Larimer & Weld Company, a further consolidation of ditches in northern Colorado under control of the Larimer & Weld Ditch Company, commonly known as the Eaton ditch, has come about.

Directors of the Palisades and Mesa irrigation districts have agreed to the compromise offered by the government and work on the construction of the high line canal will be started at once.

MONTANA.

The matter of the organization of the Tongue and Yellowstone rivers irrigation district came on for a hearing recently in the district court and it appeared that no objections had been filed to the granting of the petition.

Word comes from Malta that official notice has been received there that work on the Lower Milk River irrigation project will not be continued this summer. Settlers in the vicinity of that project are greatly disappointed, their expectations for certainty in crops each year having been founded on the belief that the work on the project would be accomplished this summer.

Work has been commenced on the long proposed irrigation project just east of Thompson, whereby the waters of the Thompson river are to be diverted and carried over a large tract of land thought to be especially suited to fruit raising. The initial project is planned to irrigate about 4,000 acres.

NEW MEXICO.

The Reclamation Service has a bunch of men at work putting in concrete headgates in the laterals below and around Otis.

The people of Farmington and near-by districts are greatly elated over the prospects of the immediate building of a high line ditch that will cover approximately 100,000 acres of now desert land.

Engineers are expected to arrive in Tucumcari soon to finish preliminary surveys of the big irrigation project of the Pajarata Irrigation Company. Work will soon be commenced on the reservoir.

There are fifteen places in the road between Farmington and Aztec where irrigation water is wasted in the public highway, according to reports.

Bids totaling over $75,000 have been awarded by the Reclamation Service for the installation within the next 90 days of a steam power plant at the site of the Elephant Butte dam.

OREGON.

In compliance with the request of settlers on the Klamath irrigation project, Secretary Fisher announced that he had indefinitely postponed the sale of 89 acres near Keno, which controls the water power site on the Klamath river.

If the latest irrigation project in Malheur county goes ahead with its work of putting water on 30,000 acres around Vale, the county seat, it will make that young city a hive of industry. The soil has wonderful fertility and the sun shines 360 days in the year.

With 4,031 votes more than the necessary two-thirds, the stockholders of the Josephine County Irrigation and Power Company, without one dissenting vote, ratified the agreement made by the directors with George Sanders, representing the Chicago and Rogue River Company, in which the directors of the Josephine Irrigation Company sold their ditch for $35,000 to the Chicago and Rogue River Company. The system will be enlarged each year.

The surveying crew of the state engineer's office, which is making a survey of the entire irrigated district of the Powder river and all the tributaries of that stream are now working at Newbridge. When the survey is completed, including all the ditches, a meeting will be called and the water rights of the entire district adjudicated.

UTAH.

Stockholders of the Lehi Irrigation Company held an important meeting recently to consider purchasing water for 1,000 acres of land to be added to their present supply. The Provo River Reservoir Company, which owns filings on Utah Lake, proposes to pump the water 85 feet high into a canal near the Saratoga Springs, conduct it through a canal 12 miles long down the west side of Jordan River, syphon it under the river and back into the Lehigh system near the Denver & Rio Grande depot.

City Engineer G. F. McGonagle is in Idaho looking over the Payette irrigation project and incidentally looking into the use of the Maginnis pipe fluming for the lateral outlet of the gravity sewer. The Maginnis pipe is being used on most of the big irrigation projects. There arose a question as to whether or not the flume would stand the alkali in the soil at the outlet of the sewer and it is to determine this question that Mr. McGonagle is investigating the usage of the pipe.

WASHINGTON.

Irrigation by means of whirling sprinklers is to be carried out on an extensive scale in the Quincy district in Grant county, upon a large tract of land a few miles south of the town of Winchester. The apparatus especially designed for the experiment is larger and of greater capacity than the sprinklers ordinarily used on city lawns. Water will be lifted from a deep well by a double action pump, driven by a gasoline engine.

More than $2,000,000 will be expended during 1911 in the Yakima and Columbia Valleys by the United States Reclamation Service, Indian Service and private corporations for the extension or betterment of irrigation projects. Much of the work has been going on this winter. Chief of the work will be the gigantic tasks of the United States Reclamation Service.

The Bumping Lake reservoir will be given finish touches, and work will be started on the Lake Keechelus reservoir. The lateral system of the Pieton project will be completed, this immense contract being in the hands of Nelson Rich, of Prosser.

R. F. Pettigrew, formerly Senator from South Dakota, testified recently in the big irrigation trial involving the waters of Moses Lake in Grant County, Washington, stating that it was his intention to irrigate 25,000 acres of his holdings if the Ham, Yearsley & Ryrie firm had not filed a contest.

The Western Irrigation and Land Company of Centralia has filed with the county auditor a plat of a tract of 17 ten-acre pieces of land on the Grand Mound prairie which will soon be put under water and sold to small fruitgrowers.

NEWS.

Charged with conspiring to defraud the government out of valuable irrigation lands included within the Payette-Boise project, Idaho, intimidation of entrymen and threats to kill in order to secure relinquishments, Horance, Nathaniel and Isaac Bray and Walter Kyle, four prominent land dealers of Boise, Idaho, were arraigned before Judge Frank S. Dietrich in the federal court of that city and pleaded not guilty. Their counsel intimated that the defendants will fight the charge to the bitter finish.

The Secretary of the Interior has awarded to Maney Brothers of Boise, Idaho, contract for the enlargement of the main south side Boise irrigation project canal.

Surveys are being made on the Bavispe river, near Angostura, Mexico, for one of the largest irrigation and hydroelectric enterprises on the continent. The Richardson Construction Company of Los Angeles, California, in which John Hays Hammond is largely interested, is promoting the project.

MISCELLANEOUS.

A mass meeting of citizens with the Pecos Commercial Club of Pecos, Texas, has been called by President Woody Johnson, when the proposed Tri-County Irrigated Lands Fair will come up for consideration, as the promoters of this fair desire to conduct the same on an elaborate plan. A proposition will also be submitted for putting down a deep well in Pecos.

The Santa Maria Irrigation Company of Santa Maria, Texas, recently filed an amendment increasing its capital stock from $10,000 to $20,000.

The state engineer's office at Pierre, S. D., recently issued a permit to Clarence McCain of Rapid Creek to appropriate twelve second-feet of water of Box Elder creek for the purpose of irrigating land. The project comprises the irrigation of about 760 acres.

Down on the Medina river, Texas, under the guiding hand of Dr. Fred Stark Pearson, one of the greatest irrigation projects in America is under way. Dr. Pearson organized a $6,000,000 corporation in London, England, and at once began work. This project will bring under cultivation 60,000 acres of rich land, which will add to the wealth of San Antonio.

There will shortly be launched in southern Idaho a reclamation project aimed to redeem from the desert 600,000 acres of sagebrush land, and to cost in round figures $25,000,000, according to Riley Atkinson, secretary of the Southern Idaho League, who was recently in Salt Lake City. The new project is the largest ever contemplated on the face of the globe, and is to be known as the Bruneau project.

A good example of the benefit of irrigating, even in Reno county, Kansas, where irrigation is not exactly a necessity, is shown at the State Reformatory Farm. Here part of the big farm has been irrigated. There is a striking contrast between the fresh, healthy looking potatoes where the water has been applied and the plants which have not been watered. The small expense of irrigating will be more than paid in the potato yield alone.

South Dakota has thousands of acres of land, which, when improved through irrigation, will provide homes for more than 2,000,000 more people, according to Governor R. S. Vessey. He spoke at a meeting of the Nineteenth National Irrigation Congress at the La Salle Hotel, Chicago.

By a deal between the state land board, Wyoming, and the Kansas City-Big Horn Irrigation Company, the Medicine Wheel Irrigation project in Big Horn county, Wyoming, is to be taken over at once by the company and rushed to completion. The project embraces 19,000 acres east of Iona, which will be ready for settlers next year.

Aurora, Illinois, men, interested in the Wyoming Irrigation Company, have done exceedingly well on their investment. The company has sold 20,000 acres of land which will be occupied by 150 Boer families as a settlement, the consideration being about $900,000.

One of the most important irrigation deals, assuring the irrigation of bench lands between Ontario, Oregon and Nyssa, Idaho, was closed recently, 10,000 acres being included. The water will be pumped from the Snake river, 4½ miles above Nyssa. The result of the pumping on this project will be watched with great interest over the Northwest generally, as it is the first large tract upon which an attempt has been made to pump water for irrigation.

Irrigation projects are receiving serious government attention in Brazil, particularly in the northern states, with their total irrigable area of 500,000 acres and their 2,000,000 people.

THE BELLE-FOURCHE IRRIGATION PROJECT.

The Secretary of the Interior has issued the following order for the purpose of relieving the present situation on the Belle-Forche irrigation project, South Dakota, pending the issue of public notice modifying or abrogating the notices heretofore issued.

A stay of proceedings looking to the cancellation of entries or water right applications because of failure to make payment will become effective as to all water right applications subject to public notices heretofore issued upon the payment of $1.50 per acre on or before March 31, 1911, subject however to future compliance with the conditions of a public notice to be hereafter issued making an increased building charge which shall be between $35 and $38 per acre. Such stay of proceedings shall remain in effect until further announcement by means of a public notice or otherwise. No water will be furnished in any case unless the holdings of the applicant shall have been conformed to the farm unit shown on the approved farm unit plats.

Upon failure to make payment as herein required on or before March 31, 1911, the entry, or water-right application, or both, as the case may be, which would otherwise be subject to cancellation will be promptly canceled without further notice.

All applications for water rights filed under the provisions of the notices heretofore issued and for which the payment necessary to avoid cancellation shall have been made on or before March 31, 1911, shall be continued in effect at the same building charge as fixed in such prior notices.

The Secretary of the Interior has authorized the Reclamation Service to extend the contract with the W. J. Hoy Contracting Company, Saint Paul, Minnesota, in connection with its work of enlarging the Main South Side Canal of the Boise irrigation project, Idaho, to include the lining of a part of the canal. The contract which is now executed involves the payment of $18,000 upon completion of the work.

WHAT IRRIGATION HAS DONE.

In his annual report, recently submitted to the President, Secretary James Wilson, of the United States Department of Agriculture, devotes much space to the irrigation investigations conducted by his department. As is well known to those interested in the subject of irrigation, investigations have resulted in the accumulation of a vast quantity of information about the progress and practice of irrigation throughout the West. In recent years, in addition to the general investigations heretofore conducted, much attention has been given to assisting new settlers on the many public and private irrigation projects that have opened new irrigated land for occupancy.

"During the past year," says the Secretary, "the Office of Experiment Stations, while maintaining most of the old lines of work in its irrigation investigations, has endeavored to modify its plans as to meet the demands for information on the new issues which are constantly arising.

"This is particularly true as regards the assistance which has been given to the new settlers. The task of converting desert land into productive fileds is not easy under the most favorable conditions, but when the one who attempts it knows little or nothing about irrigated farming the difficulties are greatly increased. Those in charge of irrigation investigation in the West, have, therefore, devoted a considerable portion of their time to advising the newcomers as to the methods best adapted to their individual needs. This personal advice, supplemented by practical bulletins, has done much to prevent mistakes and to safeguard the settler from either partial or total failure.

"In former days water for irrigation purposes was both plentiful and cheap and in attempting to use it much was wasted. In many parts of the West the old wasteful methods still prevail, although the value of water has increased many fold. The results of seepage measurements of irrigation channels obtained by the Department, coupled with the high price of water rights and the rise in value of agricultural products, have induced many companies to line their main canals. As a result, many channels which formerly lost from 20 to 30 per cent of their total flow are now practically water-tight. In many cases such improvements would not have been made if the attention of the managers had not been called by our engineers to the large losses sustained and the best means of preventing this waste. In other cases farmers used large amounts of water without realizing how excessive was the use until measurements were taken. When the irrigators of the San Joaquin Valley in California first began to apply water on what had been dry farmed grain fields they frequently used over nine feet. Now about one-third of this amount is found to be ample. The water users of Greeley and neighboring districts in Colorado used to think their crops would burn up unless they had a miner's inch of water to the acre. Now they are raising crops on the same ground that are worth about four times as much with one-fourth the water formerly used. They are learning that cultivation takes the place of irrigation to a great extent.

"The demonstration farms established in former years have been maintained. These have been of great value during the past year in showing, among other things, the benefits to be derived from the use of scanty water supplies on small fields in connection with dry farming. At the Cheyenne farm during the past season, 54 bushels of oats were raised per acre with the application of only eight inches of irrigation water, while the crop grown without irrigation was practically a failure. Alfalfa yielded 4,805 pounds of hay per acre with the application of 13.2 inches, while the unirrigated field yielded only 550 pounds. Beardless barley, with the application of 9.7 inches of water, yielded 31 bushels per acre; that unirrigated and raised on summer fallowed ground yielded only 2½ bushels. At Gooding, Idaho, 8.8 tons of red clover was harvested from land which received only 19 inches of irrigation water. These results show what can be done with a limited supply of water when properly applied.

PERSONAL.

Mr. R. E. Wilson, formerly Industrial Agent of the Atchison, Topeka & Santa Fe Ry., has been appointed Industrial Agent of the Union Depot Bridge and Terminal Ry. Co., with headquarters at Kansas City, Mo.

IRRIGATION STATISTICS OF NEW MEXICO.*

It is estimated that there are approximately 750,000 acres of irrigated land in New Mexico. It has been previously estimated that there was water supply for 2,000,000 acres, but from compilations recently made by this office assumed that there is at least water available for 4,000,000 acres. The following statement taken from water records have been collected on seven streams, will substantiate the above statement:

Streams.	Acre-feet.
Animas at Farmington	804,600
Canadian at Logan	974,340
Rio Grande at Buckman	158,018
Mimbres	7,985
Pecos at Carlsbad	438,867
San Juan River	2,050,000
	5,719,000

Six million acre-feet is of sufficient quantity to cover the entire Territory of New Mexico 0.9 inches in depth. The above statement of 4,000,000 acres is therefore conservative owing to the fact that a number of streams in the western portion of the Territory have not been included, also high run-offs for the White Mountain and Alamogordo drainage basin. In connection with the stream flow records and river profile it is estimated that there is 500,000 H. P. as yet undeveloped in this Territory. Seven thousand dollars is being spent annually by the Territory in collecting official records on the water resources of New Mexico. This work is being carried on under the most up-to-date methods, using the most important stations. The Friez automatic gages, of which there are thirteen now in operation and five Bristol automatic gages. In this important work New Mexico ranks as high as any other state east of the slope of the Rocky mountains. Three hydrographic surveys for the adjudication of water rights have been completed, namely: The Black, Hondo and Rayado rivers.

*By C. N. Miller, Territorial Engineer.

Under the provisions of the Carey Act acceptance passed by the 1909 Legislature, there have been two segregations practically made amounting to 20,000 acres, 10,000 by the Lake Charette Reservoir and Ditch Co., Springer, New Mexico, and 10,000 acres by the Oasis Development Co., Artesia, New Mexico. It is expected that 150,000 acres will be segregated under the provisions of this law within the year 1911.

Under the provisions of the irrigation district law, two projects have been formulated and are now doing construction work. Orchard District Irrigation Company, of Aztec, New Mexico, 12,000 acres. Las Vegas Irrigation District, Las Vegas, New Mexico, was for 16,000 acres. In spite of general conditions of irrigation bonds throughout the country, securities of this character in New Mexico have proven acceptable to Eastern capitalists.

Active construction work has been commenced on the Rio Grande Elephant Butte project of the U. S. Reclamation Service which covers 180,000 acres of land and stores 2,000,000 acre feet per annum and will cost approximately $10,000,000 when completed. Final completion estimated in about seven years. This project covers 110,000 acres of land in New Mexico, in the Mesilla, Rincon and Palomas valleys.

There have been filed in the office of the Territorial Engineer since January 1st, 1909, to February 1st, 1911, 309 applications for permits to appropriate public water; 242 have been for irrigation purposes and cover approximately 1,000,000 acres of land (this one million acres of land is additional to acreage applied for prior to January 1st, 1909) and 67 have been for power, mining, milling, etc., purposes. The amount of horse power covers approximately 100,000, which is also additional to those previously applied for.

Reclamation work at Project spur, about 20 miles from Hazen, Nevada, has been commenced by a party of 30 men under the direction of U. S. Engineer Tillinghast. Work will be started on the dam as soon as spring opens, when it will be necessary to employ a large force of men.

METHOD OF IRRIGATION FOR ALFALFA.

More and more is alfalfa coming to be recognized as one of the most important of farm crops, especially in the arid and semi-arid sections of the West.

These sections begin with Nebraska and sweep westward to the Pacific Coast. Colorado is probably the leading alfalfa growing state of the Union; California comes next; and not only in these states, but in all others within the boundaries of the sections named the acreage of alfalfa is being rapidly increased.

And alfalfa, being a product of the arid and semi-arid sections, its production implies the process of irrigation, and in this connection Prof. Samuel Fortier, chief of irrigation investigations of the United States experiment Station, has just issued an important bulletin on "Irrigation of Alfalfa." Prof. Fortier groups the prevailing methods as the border method, the check method, flooding from field laterals, furrow irrigation, etc., and says:

"Essentially the border method consists of the division of a field or tract into long, narrow strips or lands by low, flat levees which usually extend in the direction of the steepest slope and confine the water to a single strip. The bed of each strip is carefully graded to a uniform slope, although the slope may change to conform to the contour of the natural surface.

"The water to irrigate each strip is taken from the head ditch extending across the upper edge of the field and is controlled by an outlet box or border gate, although the gates are sometimes omitted to save in first cost of preparing for irrigation. Check gates, canvas dams or metal tappons are used to hold up the water in the head ditch to cause it to flow into the borders.

"This method is confined chiefly to the irrigation of alfalfa and grain and in its various modifications is used extensively in Arizona, California and to a less extent in Idaho, Montana and other Rocky Mountain States.

"The essential features of the check method of irrigation consist in surrounding nearly level plats of ground with low levels and in making provision to flood each by means of a ditch and check box or gate. The inclosed spaces may be laid out in straight lines in both directions, thus forming with their level borders a series of rectangles, or the levels may follow more or less closely the contour lines of the natural surface of the ground, thus forming contour checks. This method is used on heavy soils where it is necessary to hold the water on the soil to secure its perculation to the desired depth.

"Flooding from field ditches or laterals is still the most common method of applying water to arid lands of western America. In the States of Colorado, Montana, Wyoming, Utah and to a large extent in Idaho alfalfa, clover, native meadows and grain are irrigated in this way.

"This manner of wetting dry soil originated, it is believed, in the mountain states and the last half century has witnessed a gradual evolution of this plan so that now it has not only become firmly established, but is regarded as the best suited to the conditions under which it is practiced.

"It can profitably be used on slopes that are too steep for other methods. Fields having a firm soil and a fall of from 25 feet to 100 feet have been flooded successfully. From this extreme the slope may diminish to less than 0.1 in 100.

"Its cheapness is another feature which recommends it to the farmer of limited means. Ordinary raw land can be prepared for flooding at an expense of from $2 to $5 an acre. Again, it is adapted to the use of small water supplies.

"Alfalfa, native meadow and grain are most commonly irrigated by one of the methods previously described rather than by the furrow method, which is the usual method of irrigating orchards, gardens, root crops and vegetables. The irrigating of alfalfa from furrows is at present confined to the Yakima Valley, Washington, to portions of the Snake River Valley, in southern Idaho, and to comparatively small areas in other states.

"In the localities named, the soil is a fine clay loam which runs together, puddles when wet and bakes and cracks when dry. Flooding methods tend to puddle the top layer of soil, which becomes quite hard when the moisture is evaporated.

"The puddling and baking processes injure alfalfa and it was with the object of keeping as much as possible of the surface dry that furrows were introduced. When a small stream is permitted to run in the bottom of a furrow for several hours the soil beneath, and for some distance on each side, becomes wet, while the surface may remain nearly dry."—*Orchard and Farm.*

The Secretary of the Interior has ratified the award and execution of a contract on behalf of the United States with Mr. Jesse Hinds of Bayard, Nebraska, by which the latter agrees to construct high line lateral in connection with the North Platte irrigation project, Nebraska-Wyoming. The work involves the excavation of approximately 107,500 cubic yards of material, and the contract price is $12,315. The location of this canal is about thirteen miles northeast of Scottsbluff, Nebraska.

70-Acre Cherry Orchard on the Fountain Valley Land and Irrigation Company's Project.

Fountain Valley, Colorado

The country of sunshine, fine soil, good crops and delightful scenery

Fountain Valley, Colorado, is recognized throughout the United States as one of the most attractive sections of the West.

This tract is located between Colorado Springs and the town of Fountain. The section is world famed as a health resort—many of the larger fraternal organizations of the United States have established homes for their ailing members at or near Colorado Springs.

The Fountain Valley tract is, moreover, particularly favored and its superiority pronounced by the fact of its fine markets. Colorado Springs, Manitou, Cripple Creek, Victor, Colorado City (points directly connected with this tract), and other mining markets, to which Colorado Springs is the gateway, such as Leadville, serve, altogether, a population of over 200,000 people. This is in addition to the annual gathering of tourists at or near Colorado Springs, estimated at something like 200,000 people. Aside from the Fountain Valley, all of these places must secure their supplies from distant points, such as Greeley, through Denver on the north, or from the lower Arkansas Valley, through Pueblo on the south, thereby giving Fountain Valley a great advantage in the matter of freight rates. This valley competes successfully in the markets of Denver and Pueblo.

Alfalfa in the Fountain Valley yields larger returns in money than any other known place in the world, due to the superior markets.

Land may be purchased in this delightful section at reasonable prices and on favorable terms.

For finely illustrated folders fully describing this section, address

The Fountain Valley Land and Irrigation Company

Boston Block, Denver, Colorado

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WATER SUPPLY OF THE GREAT BASIN.

The Geological Survey's census of the water resources of the United States is contained in a series of its reports called "water-supply papers," the latest issue of which, No. 270, is devoted to the waters of the Great Basin, comprising western Utah, nearly all of Nevada, and parts of Idaho, Oregon, and California. The report describes the general features of the basin and gives the discharge of the most important streams of the region as shown by measurements made at numerous stations during the year 1909.

In this arid region water is precious and is applied mainly to irrigation. The Truckee-Carson and Strawberry Valley projects of the United States Reclamation Service and a number of private projects are designed to utilize the waters of some of the streams measured. Three of the streams—City, Parleys, and Emigration creeks—furnish most of Salt Lake City's water supply.

The flow of some of the streams has been used to generate electric power, and there are many unutilized sites for good power plants. The report notes that more than 100,000 horse power is available without storage in Owens river basin alone. Three power plants installed on Truckee river generate about 2,500 horse power each.

The report was prepared by E. C. La Rue and F. F. Henshaw, and can be obtained free by applying to the Direstor of the United States Geological Survey, Washington, D. C.

The Texas Legislature passed, under suspension of the rules, recently, the Kilpatrick bill, which is intended to bring the reclamation of waste lands in Ohio county to agriculture.

A New York dispatch says: "It is learned definitely that recently the Canadian Pacific Railway Company bought from the Hudson Bay Company about 100,000 acres of land adjoining the section of the land already owned by the Canadian Pacific, which it is putting under irrigation as rapidly as possible. It is understood that the price paid was about $1,380,000. It is expected that this land will be ready to be put on the market next year."

For the purpose of reclaiming a large portion of the 2,500,000 acres of surveyed government land open to settlement in White Pine county, Nev., a corporation known as the Western Land & Irrigation syndicate has been formed.

Thirty million acres of land, enough to provide homes for 2,000,000 families, are yet to be irrigated in the west. The cost of putting the project through would be, approximately, five times as great as is the cost of constructing the Panama Canal.

DESIRABLE LAND FOR SALE I NMONTANA.

640 Acres—Three miles east of Canyon Ferry on the extreme lower end of the Missouri valley and Broadwater county, 8 miles north and east of Winston and 15 miles due east of Helena. This tract is 98 per cent tillable, and in what is known to be one of the very finest Dry Farming districts in the state. Last year an adjoining ranch made 35 bushels of wheat to the acre. This would make an exceptionally fine wheat ranch, and which is a bargain at the price of $20.00 per acre, one-half cash, and the balance in five equal annual payments, with interest at the rate of 6 per cent.

320 Acres—Six miles south and east of the above described tract which is 8 miles due east of Winston. This small ranch is located in the heart of one of the finest Fruit Districts in our state. A few miles north is an orchard of 15 acres which bears large crops of apples annually, the apples being unusually large and of an exceptionally fine flavor and color. There are other small orchards south and west. Lying close as it does to the mountain would make an excellent ranch for Live Stock. This tract is 90 per cent tillable. Domestic water could be had the year round. The price is $22.50 per acre, one-half cash, and the balance in 5 equal annual payments at the rate of 6 per cent interest.

Address all inquiries to W. E. Crowley, care Irrigation Age, Chicago.

POINTS ON ALFALFA GROWING IN COLORADO.

1. Moisture in the subsoil is as essential as the moisture for germination, to insure a stand of alfalfa. If the subsoil is dry, there must be irrigation soon after seeding.

2. Sow only on a well prepared, settled seed bed; loose. newly plowed soil is a hazardous risk, unless the soil is immediately settled by heavy rains or irrigation.

3. Sow alfalfa seed early if moisture is available; if not, sow at the season when there is the greatest prospect for moisture from rains or irrigation.

4. Sow alfalfa seed shallow, not more than one inch deep. Broadcast and then harrowing is usually a succesful method, if moisture is present; but a press-shoe-drill seeding, about an inch in depth, would be an ideal method of seeding broadcast fields for hay production.

5. Sow northern, acclimated strains of alfalfa. The Arabian and any of the tropical strains of alfalfa are not hardy in southern Colorado.

6. Ten to twelve pounds of first-grade seed is plenty to sow per acre; that will be at least fifty seeds per square foot, which will be ample if conditions are right. Thorough preparation is cheaper than twenty to thirty pounds sown where the conditions are uncertain.

7. Sow with a nurse crop ONLY when there is plenty of water for irrigation. Oats, barley and wheat are good nurse crops, but should be sown at least two-thirds of a usual seeding for grain.

8. Spring seeded nurse crops should be cut for hay, rather than left to ripen for grain, as the young alfalfa will usually suffer for water before the grain is ripe and the field cleared and irrigated.

9. On land inclined to blow, sow alfalfa in grain or cane stubbble without plowing. The stubble checks the wind and does not rob the plant for moisture.

10. Irrigate often, and do not fail to irrigate in late summer and fall, if you want the best results from your stand of young alfalfa.

11. Keep down the weeds. Better seed alfalfa on clean land, but cut off with a mower if the weeds get started. DO NOT CLIP ALFALFA UNTIL THE CROWN BUDS HAVE DEVELOPED. Grasshoppers often injure a stand of alfalfa by eating off the leaves and top before the buds have started at the surface of the ground. Early seeding is preferred on this account.

1. Irrigate frequently rather than by long continued soakings; over watering excludes air and compacts the soil.

2. An irrigation in the fall, to insure soil moisture over winter, is worth two irrigations in the spring after the soil has been dry all winter. If moisture is present over winter, the alfalfa plant makes root and bud growth preparatory for next season's crop. If the soil is dry, the plant becomes so dormant that it will take weeks of time to develop new buds and root hairs. Winter moisture in the soil, with frost action, also breaks up compacted soil conditions that will help to conserve the subsoil moisture and increase the hay yield.

3. Avoid pasturing alfalfa fields, especially when wet.

4. Cultivate alfalfa fields early in the spring, with the alfalfa renovator, disk, spring-tooth harrow, or any special alfalfa cultivator, for the following reasons:

(1) To break up compact soil conditions.
(2) To get air into the soil, which is very essential.
(3) To work leaves and other organic matter into the soil.
(4) To break up capillary action, thus conserving moisture.
(5) To destroy foxtail sod, grasshopper eggs, and other pests.

5. Do not let ice form over alfalfa fields by winter irrigation for any length of time.

6. Rowing out the alfalfa hay field affords a better system of irrigation than the ordinary flooding method often practiced that so often oversoaks the field, to the detriment of the yield of hay.

7. Cut alfalfa for hay when the growth checks and the plant puts out new shoots from the crown; this is usually about the time the plant is well started to bloom.

8. In curing alfalfa hay it should be done in the windrow and cock rather than in the swath, as the leaves will shatter if suddenly dried up in the sun. The undried green leaf is an important factor in reducing the sap in the stems in the curing process.

PHILO K. BLINN,
Alfalfa Specialist,
Colorado Agricultural College, Fort Collins.

In the system of irrigation under construction by the Canadian Pacific Railway, 1,586 miles of canals and ditches have been completed, the contemplated project totaling 4,500 miles. The total expenditure will be about $16,000,000, irrigating a tract of 3,000,000 acres.

Five big cars belonging to the Bitter Root Irrigation Company arrived in Hamilton, Mont., recently, loaded with a party of land lookers. The entire party was taken for an inspection of Lake Como and Lake Como dam.

At the annual meeting of the Brownsville Irrigation Company of Brownsville, Texas, the following officers were elected: A. W. Gardiner of Houston, president; Lon C. Hill of Harlingen, vice-president; A. W. Wood, Brownsville, secretary and treasurer.

NINETEENTH NATIONAL IRRIGATION CONGRESS.

When the Nineteenth Irrigation Congress meets in Chicago next December it will be an international instead of merely national body, if the plans of certain members of the board of control are carried out. The board of control is composed of the following members:

Henry A. Allen
C. P. Anderson
D. H. Anderson
Bion J. Arnold
F. C. Austin
Alfred L. Baker
Frank I. Bennett
W. J. Black
Leonard J. Blades, Jr.
William A. Bond
Munson P. Buel
William B. Bogert
William H. Bush
H. M. Byllesby
Edward F. Carry
George W. Dixon
Hugo Du Brock
Clinton B. Evans
Victor Falkenau
Don Farnsworth
Samuel Fallows
William A. Gardner
William H. Manss
Clayton V. Mark
R. R. McCormick
James A. McLane
Frank R. McMullin
Walter E. Miller
Walter L. Moody
Joy Morton
H. U. Mudge
Robert T. Nelson
LaVerne W. Noyes
Harrison M. Parker
L. B. Patterson
Isham Randolph
Charles H. Ravell
Alexander H. Ravell
George M. Reynolds
Harrison B. Riley
Fred J. Ringley
George B. Robbins
R. J. Roulston
George W. Sheldon
Judson F. Going
Edward M. Hagar
Richard C. Hall
John D. Hibbard
William Holabird
Robert W. Hunt
Rev. Jenkin Lloyd Jones
Joseph F. Kelly
George Thomas Kelly
Thomas D. Knight
Julius Kruttschnitt
E. Louis Kuhns
Francis M. Lane
Frank C. Letts
William A. Lydon
Eames MacVeagh
Francis W. Shepardson
Willard A. Smith
John A. Spoor
Mason B. Starring
H. L. Taft
Roy A. H. Thompson
Dr. Fenton B. Turck
Fred W. Upham
W. F. Van Buskirk
W. C. Vandervoort
J. C. Vaughan
W. C. Vierbuchen
Charles J. Vopicka
H. U. Wallace
T. K. Webster
Henry C. Wood

President Taft has already given his consent to speak at the congress.

MISCELLANEOUS.

The world's largest land and irrigation exposition will be held in Madison Square Garden at New York City from November 3rd to November 12th, 1911.

The Oregon Agricultural College will have charge of the experimental farm now being put in shape alongside the West Stayton depot. Ten acres have already been set to various crops to demonstrate what irrigation in summer will accomplish.

FARMERS' CLUBS.

Farmers' Clubs can be made social centers as well as the place for exchanging experiences on farm and home topics.

This is the day of coöperation or combination. Men in all lines of effort except possibly the farmer, come together at more or less regular intervals to talk over their work, to give each other the benefits of each other's experiences, and to come to a better understanding in their business relations. The different manufacturers, the editors, the retailers, the scientists, the educators, laborers, etc., hold meetings. Why not the farmers? We are in more need of it than any of the others, from the social standpoint, from the standpoint of swapping experiences, and from

As farmers we live more or less isolated the standpoint of a better understanding of business matters.

and our work is so varied that it has something of interest and that needs attention all the time, yet we must learn to drop it all for a social hour occasionally and for our wives and children as well as for ourselves. In fact they need it more than we do as there is not the variety in their work nor so much to hold their interest and attention.

In every community there are some farmers who are making a good success with some thing, as growing corn, trees, potatoes, fruit, or raising cattle, hogs, horses, etc. There is no magic about it, except doing the right thing at the right time, and they would be glad to tell how it was done. They are likely not ready speakers before a large audience but in a conversational way they can tell the story. If all were to study and try to improve along the lines of the successful farmer it would make the community an outstanding one.

Then there are the good wives in every community who have had fine success in some line of their work, as making bread, canning fruit, growing flowers, house decoration and the hundred and one other things.

The community has among its members those who can teach each other from their own experiences, and the farmers' club with its stated meetings is the ideal place to gather and exchange this valuable information. Few realize how valuable they are. Reports could also be made on bulletins from the Agricultural Experiment Stations and on articles in the Agricultural papers and magazines.

Such a club would bring together a great teaching force; specialists in almost every line of farm and home activity. It would be a great incentive to make these specialists study deeper into their lines of work, to learn more of what others have done. Speakers can often be secured from the Agricultural College and Farmers' Institute. Now do not under-estimate your worth to the community nor your qualifications for instructing others. No information is so valuable as that which comes from a man or woman who has actually secured results.

A SAMPLE OF GOOD GRADING.

An interesting piece of road grading work has recently been completed by Thornton Bros. at South St. Paul, Minn. Using a Big Four "30" four-cylinder gas traction engine made by the Gas Traction Company of Minneapolis, and a Russell elevating grader and ditcher, they took out an average of 1,000 cubic yards of earth a day, using eleven teams and one-and-one-half-yard dump wagons and hauling from one and one-half to five blocks, or an average of three blocks.

As many as ninety loads an hour were taken out—and if there had been no time lost waiting for teams, 100 loads could easily have been taken out in an hour. The best Thornton Bros. were ever able to do with their steam engine was fifty loads an hour. With the gas engine a much deeper cut can be taken than is possible with horses, and the engine travels easily in mud where it is impossible to work horses.

The fact that the engine costs absolutely nothing for maintenance when it is not at work is a very important consideration with road and grading contractors, who have to feed and care for large numbers of horses through long periods when they are not at work. When the engine is not at work, no expense can be charged against it, other than interest on the investment, and depreciation. If the engine is properly cared for, the depreciation amounts to very little, for the few parts that can wear out can be replaced at moderate expense. Interest, maintenance and depreciation are seldom charged in figuring the expense of horse traction, but they should be and when they are the comparison favors the engine.

Grading and road construction work makes peculiar demands upon an engine; it calls for a machine which has an ample power reserve, which can travel easily over soft ground and loose earth and up and down all kinds of grades and which is under perfect and instantaneous control of the operator. The lightest of the 30 h. p. gas traction engines weighs only eight and three-fourths tons, and its weight is so distributed that the pressure per square inch under its drivers is less than that per square inch under a horses'

hoof. The drivers are eight feet high, with rims two feet wide, with conical self-cleaning lugs which take a firm hold on the ground and make slipping impossible. The front wheels and steering mechanism are so arranged that the engine can turn in small space, another advantage in construction work.

The Louis Lake Irrigation and Power Company's project to irrigate 45,000 acres of land in Fremont county, tained in the district.
Wyoming, and to supply the mines at South Pass, Atlantic and Miners' Delight, with light and power is assured. The company has secured a water right to the headwaters of the Little Popoagie river and the land is now being segregated under the Carey act through the Lander land office.

STRAWBERRY VALLEY IRRIGATION TUNNEL.

An interesting account of the work on the Strawberry Tunnel, Strawberry Valley Irrigation project, Utah, has just been received from the engineer in charge. This tunnel, which will have a total length of 19,200 feet, or more than 3½ miles, will bring water from the Colorado River drainage basin through the Divide into the Great Basin. Its capacity will be about 500 second-feet.

To date, 11,190 feet of this tunnel have been excavated, the progress during the past month being 290 feet. The prevailing material encountered was red and gray sandstone, with an occasional strata of limestone. Water has dripped from the roof at the face during the entire month, making it difficult and unpleasant for the workmen, and the flow of water from the mouth of the heading is about 7 second-feet. The best rubber clothing can not keep out the cold water, and the men are constantly quitting, the average time worked being from 5 to 10 shifts.

The work of lining the tunnel with concrete is following the excavation, 359 feet of the sides and arch, and 998 feet of floor lining having been put in during the past month. In order to put in the bottom lining the floor is unwatered by means of a cofferdam and two 14" pipes. The water is backed up 2' or more in depth and the pipes are laid along each side of the tunnel a few inches above the grade, extending through the cofferdam. This scheme is considered preferable to pumping, as it saves the wages of three pump men. The bottom is unwatered in 500-foot sections. A recent snowfall put the roads in such condition that the tunnel is cut off from the rest of the world, all freighting having been suspended. A box of emergency provisions has been placed in the tunnel near the heading, containing pilot bread, pork and beans, tomatoes, etc.

A bond of $400,000 was filed with the board of directors of the Bent and Prowers Irrigation district by the Southwest Constructive Company of Lamar, which company holds the contract for the construction of the system for the irrigation of about 80,000 acres of land contained in the district.

IMPORTANT NOTICE OF THE YAKIMA IRRIGATION PROJECT.

The Secretary of the Interior has issued a public notice announcing that on and after April 6, 1911, homestead entries may be made on lands under the Tieton Unit of the Yakima irrigation project, Washington, for the farm units shown on the following plats:

Town 13 North, Range 17 East.
Town 13 North, Range 18 East.
Town 14 North, Range 16 East.
Town 14 North, Range 17 East.
Town 14 North, Range 18 East.
Town 16 North, Range 16 East.

Each entry must be accompanied by water right application and by payment of at least one installment of the building, maintenance and operation charges, not less than $10.80 per acre. The second installment will be payable on April 1, of the following year, and subsequent installments will be due on April 1 of each year thereafter until fully paid. All charges are payable at the local land office at North Yakima, Washington. No water will be furnished in any year until the portion of the charges for operation and maintenance then due shall have been paid. The amount of water to be furnished shall, until further notice, be not to exceed 2.17 acre-feet per acre per annum. The charge for building works is $93 per acre and the number of payments are not to exceed ten.

An irrigation project, which will result in the reclamation of 50,000 acres of dormant land in Elko County, Nevada, has just been started under the direction of Engineer Van Nagle, assistant to State Engineer Kearney and representatives of the Pacific Reclamation Company. The proposed project is for storing the waters of Marys River and irrigating lands under the Carey act lying east of the river and extending across Taber Creek to the lands irrigated by Bishop Creek.

NEW CORPORATIONS.

Louisiana.

Eddich Reclamation Company; capital, $50,000. Officers: John A, Kruse, Charles Carroll, Joseph W. Carroll and Sam Henderson, Jr.

Colorado.

Werner Land and Irrigation Co.; capital, $35.000. M. Ed Werner, William Werner, Herman Werner, Saguache.

New Jersey.

Pine Aire Development and Irrigation Co. of Montclair; real estate, builders, contractors, etc.; capital, $500,000. Incorporators: O. F. Clifford, A. S. Badgley, W. D. Stratton, Montclair.

California.

Fresno Valley Irrigation Company; capital stock, $6,000; subscribed, $6,000. M. M. Ritterband, C. E. Davenport, S. F. Steinberg, H. M. Lindsey and Emil Firth, directors.

Washington.

Klickitat Power & Irrigation Company, of Goldendale; capital stock, $250,000. W. R. Brown, Charles M. Drew et al.

Oklahoma.

Western Power and Irrigation Company of Oklahoma City; capital stock, $500,000. Incorporators: George W. Frye and C. E. Berryman of Oklahoma City; W. Holton Key of Mayville, Ky.

Texas.

The Carla Land and Irrigation Company of Carla; capital stock, $100,000. Incorporators: C. R. Wild, Carl A. Albrecht, and Colon Schott.

New Mexico.

Hope Community Irrigation Company of Hope, Eddy county; capitalization, $441,000; C. M. Botts, statutory agent. Incorporators and directors are: T. V. Coffin, W. P. Riley, W. J. Lewis, H. M. Gage, and C. M. Botts.

The Briggs Irrigation Company of Willard, Torrance county; capitalization, $50,000. Incorporators and directors are: S. V. Briggs, Frederick Briggs, W. W. Hubbard, of Willard.

Utah.

Articles of amendment to Dry Gulch Irrigation Company; capitalization increased from $100,000 to $800,000 in $10 shares.

Trenton Irrigation Company of Logan, general irrigation business; capital stock, $400,000 in $10 shares. John A. Hendrickson, president; E. R. Miles, Jr., first vice-president; John Q. Adams, second vice-president; Louis S. Cardon, secretary and treasurer.

A CATALOGUE WORTH HAVING.

F. E. Meyers & Bro., of Ashland, Ohio, have recently issued a catalogue showing a large assortment of spraying pumps and accessories with full description and price lists. The catalogue is fully illustrated and should be a valuable addition to the reference libraries of our readers, especially to those in need of spraying apparatus and pumps; an illustrated article on scientific spraying of ten pages and a spray calendar giving tabular information when and how to spray the different crops is a part of the catalogue and will be of especial interest to any one raising fruit or vegetables. The catalogue will be sent upon request.

The Temple Irrigation Equipments the most Economical and Certain Means of Lifting Water

55 YEARS' EXPERIENCE

Write us for Information and Prices—State Requirements

CENTRIFUGAL PUMP AND GASOLINE ENGINE IRRIGATION OUTFIT

The Temple Water Elevators—The Temple Centrifugal Pumps

Manufacturers of all kinds of Hand and Windmill Pumps

Also Manufacturers Single Cylinder, Double Cylinder and Four Cylinder Gasoline or Kerosene Engines

Briefly stated the advantages of our Double Cylinder Engines are as follows:

First—They are more economical in the use of fuel. On light loads one cylinder can be used, reserving both cylinders for heavy loads.

Second—Although weighing about one-half the weight of a single cylinder engine of same rated capacity, vibrations are practically overcome, demonstrating conclusively that in proportion to strain, the double cylinder "Master Workman" is the stronger engine.

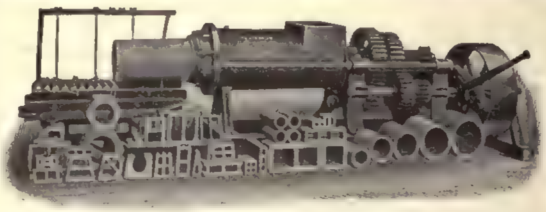
Third—The heavier weight of a single cylinder engine is due to the fact that it must have heavier fly wheels in the horizontal type, and a longer, higher and consequently much heavier base than is required for the "Master Workman." The heavier the fly-wheels the greater the strain on the crankshaft, so you will realize that neither heavier fly-wheels nor a heavier base contribute one iota to the strength of a single cylinder engine.

Fourth—When vibrations are overcome, as in the "Master Workman," the lighter the engine and the less cumbersome it is, the greater its sphere of usefulness and the cheaper and more convenient it can be handled.

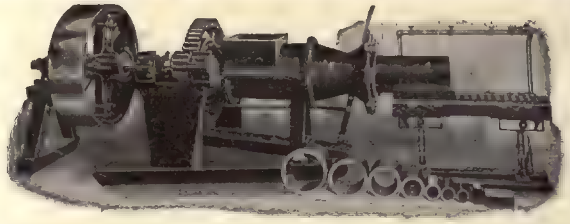
Fifth—Lubrication in our engine is absolutely perfect. There is no forced lubrication, lubrication being by gravity. Certainty of lubrication is of vital importance in the steady running and operation of a gasoline engine.

Sixth—All mechanism is in full view, which will enable you to thoroughly understand the operation of a gasoline engine. The worst kind of complexity is concealed mechanism.

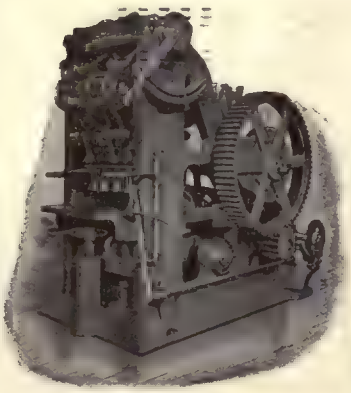
THE TEMPLE PUMP CO., Factory, 15th St. and 15th Place, near Canal St. Chicago, Ill., U. S. A.



Centennial Auger Machine

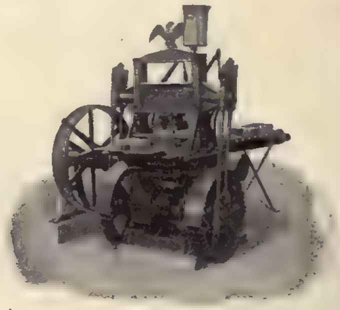


Mascot Auger Machine



Dry Press, 5 styles

Wheelbarrows and Trucks



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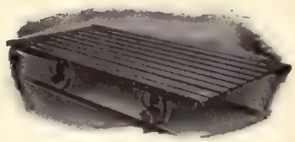
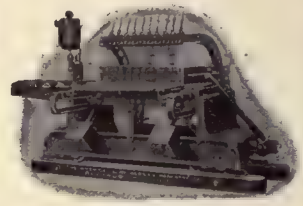
We build an entire line of Clay Working Machinery for the manufacture of Clay products by all processes, including Sand-Line Brick. Our yard supplies are the best. Kiln Irons, Cutting Wire and all supplies. Send for information or catalogue.

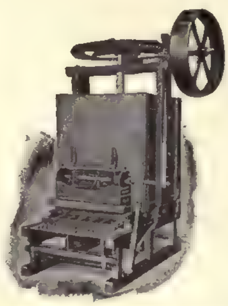
The American Clay Mch. Co...Bucyrus, Ohio



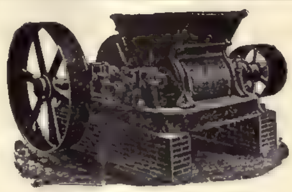
Dry Cars, all kinds



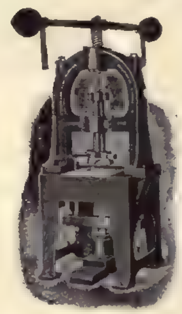
Hand and Power Cutters



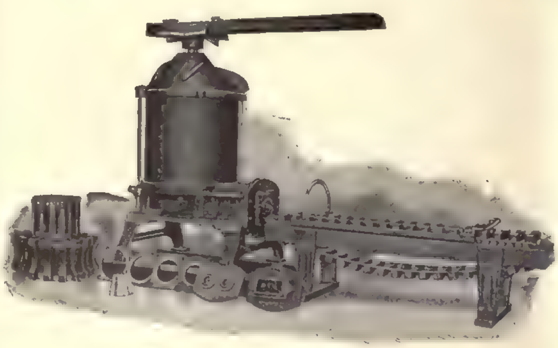
Soft Mud Machines, Horse and Steam Power



Disintegraters



Hand Power Screw Press



Horse Power Plunger Machine

Products of our Auger Machines

Myers Power Pumps

Working Heads, Pumping Jacks, Cylinders, Etc.

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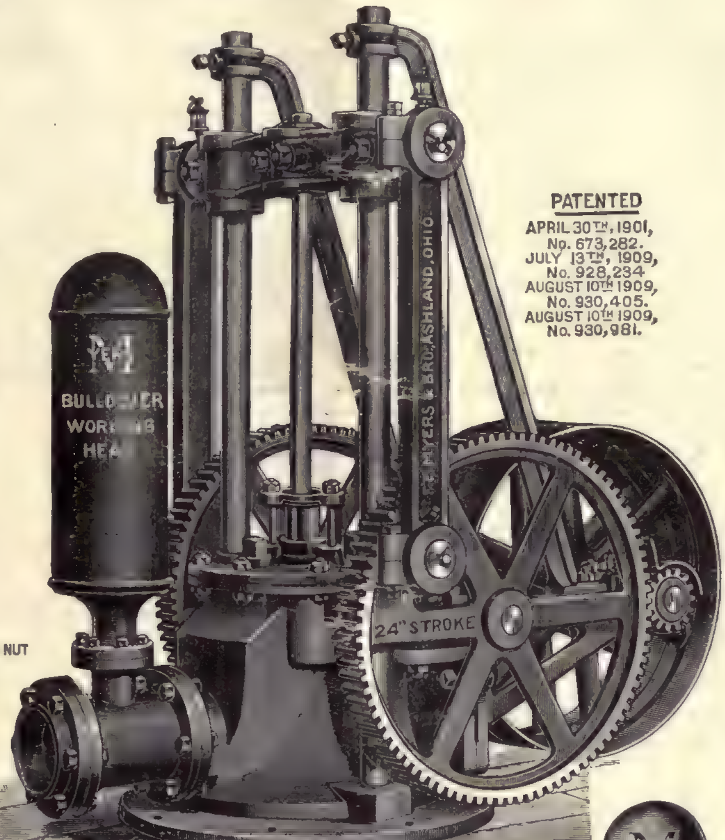
The Myers Bulldozer Power Working Heads For Deep Wells

Length of Stroke 5 to 24 inches

Size of Discharge Up to 6 inches



PATENTED

The Myers Bulldozer Power Pumps For Shallow Wells

Double Acting Length of Stroke 5 to 20 inches

Size of Cylinders 2½ to 6 inches

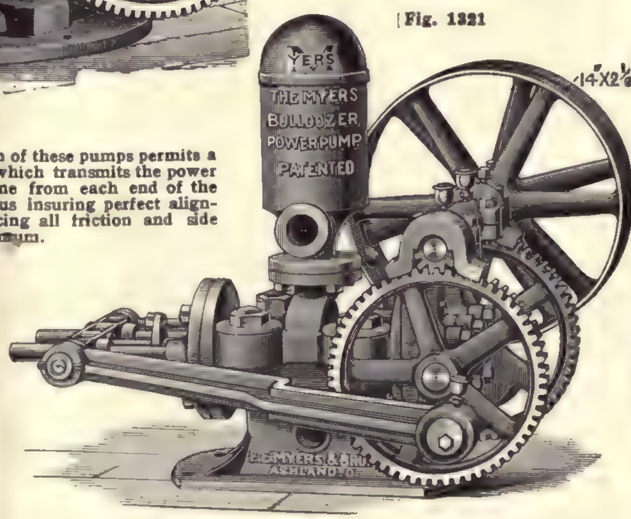
Size of Discharge Up to 4 inches

Capacities 600 to 7200 Gallons per Hour

The construction of these pumps permits a double gearing which transmits the power in two lines—one from each end of the same shaft, thus insuring perfect alignment and reducing all friction and side strain to a minimum.

Write for Catalogue and Prices

Fig. 1321



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ASHLAND PUMP AND HAY TOOL WORKS

Plow Deeper and Harrow Oftener—You Will Get Bigger Returns

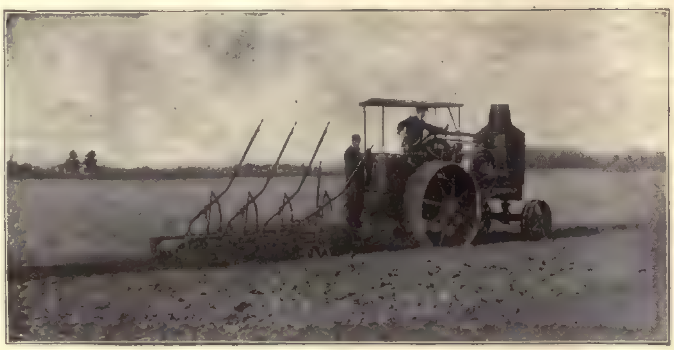
Bigger returns mean more bushels; more bushels, more money; more money, more of the pleasures of life—*so make your farming more intensive.*

Deeper plowing loosens the fertility of lower soil strata, exposes a larger mass of soil to the air, improves the surface drainage, builds a deeper storage basin for water, gives the roots a better chance to grow and thereby makes healthier, stronger and better plants.

By pulverizing the soil more thoroughly and harrowing oftener a great deal more moisture can be locked up in the soil and the crops insured against drought.

The Better the Agriculture The More Power Required

The negro in the South has only the power of the mule, while the Iowa farmer has the power of three and one-half horses to aid him. But a more efficient, stronger and quicker power than horses is required nowadays to increase yields. Deeper plowing, more frequent and thorough harrowing can be done better, easier and with less expense with a tractor than with horses.



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Twenty-sixth Year

THE IRRIGATION AGE

VOL. XXVI CHICAGO, AUGUST, 1911. NO. 10

THE IRRIGATION AGE

With which is Merged

MODERN IRRIGATION / THE DRAINAGE JOURNAL / THE IRRIGATION ERA / MID-WEST / ARID AMERICA / THE FARM HERALD

D. H. ANDERSON
PUBLISHER,

30 No. Dearborn Street, - - CHICAGO
Old No. 112 Dearborn St.

Entered as second-class matter October 3, 1897, at the Postoffice at Chicago, Ill., under Act of March 3, 1879.

D. H. ANDERSON, Editor

ANNOUNCEMENT.

"The Primer of Irrigation" is now ready for delivery. Price, $2.00. If ordered in connection with subscription, the price is $1.50.

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Official organ Federation of Tree Growing Clubs of America. D. H. Anderson, Secretary.

Official organ of the American Irrigation Federation. Office of the Secretary, 212 Boyce Building, Chicago.

Interesting to Advertisers.

It may interest advertisers to know that The Irrigation Age is the only publication in the world having an actual paid in advance circulation among individual irrigators and large irrigation corporations. It is read regularly by all interested in this subject and has readers in all parts of the world. The Irrigation Age is 26 years old and is the pioneer publication of its class in the world.

CONTENTS.

The Reclamation of the Southern Swamp Lands. The proposed reclamation of the swamp lands in the South by the federal government or with the aid of said government may meet defeat on account of the fact that the government does not own the land, excepting the swamp land in the thirteen original states, which is owned by the government. All the swamp lands in the other states were granted to the various states by Congress on condition that they reclaim the land. Very little has been done in this direction except that private holders have taken hold and drained swamps, making splendid rich land of them. This successful operation has naturally set the people in these states to thinking that the immense tracts of swamp lands should all be converted into fertile and productive farms. The process of individual effort appears altogether too slow for present day practice, and therefore the government is appealed to to take hold in a manner similar to the reclamation of the arid and semi-arid lands of the West. The conditions are, however, somewhat different since the desert lands were the property of the United States and hence after the reclamation the government could dispose of the land according to its own rules and laws. With the swamp lands in question the title of which belongs to the various states the matter is different and an understanding should first be reached fixing an equitable basis whereby either the government would take the swamp lands over and charge the settlers for the actual cost of the drainage, or else have the states retain their proprietary rights and reimburse the government for its expenditures.

The problem is an important one and is a very live issue today. These swamp lands are scattered over a wide area of the eastern, southern and middle west states, much of it being near to very good markets, so that, for instance, the one million acres of swamp lands in the state of Illinois along the Mississippi and Illinois rivers could be transformed into 50,000 productive farms of 20 acres, each capable of supporting a family in comfort. This swamp land, when drained, is very rich and will yield abundant crops, so that 20 acres of the land intensively farmed provides a competence.

One danger in reclaiming swamps must not be overlooked, and that is that the water is not drawn off too low. Just recently the writer was informed that in some districts along the Kankakee river which have been drained at great expense by tiling several years ago, the ground has become so dry that the farmers are discussing the problem of irrigating their holdings. In such case the outlets of the drain tiles should be plugged until the soil has its required water, or in other words, the water bench should be raised sufficiently to bring the water to the roots of the plants.

Investigations should be made from the scientific point of view into the various phases of drainage so that this subject could be approached by the layman with greater assurance of success.

Agriculture Old and New. Agriculture is, without a doubt, one of the oldest vocations, dating back to the very origin of man, as his livelihood at all times has depended upon the exercise of this very work. Yet with all of these thousands of years of experience the methods of the farmer have been so simple and crude that up to fifty years ago the tilling of the soil was done just about the same as hundreds of years ago; nay, even at this day one may travel through the republic of Mexico and other modern countries and see the breaking of the ground done by the aid of a sharp stick of wood, just as the practice had been handed down from father to son during innumerable generations.

But a great change has been wrought in this direction, beginning about the middle of the last century, when chemistry was rapidly developing into a practical science, delving into the mysteries of organic life and laying them bare. Also the construction of machinery made marvelous progress and farming machinery of every kind made its appearance and was welcomed by the American farmer in particular for its labor saving qualities. Still the farmer was working on in the dark, so to speak, being principally governed by precedent and hearsay, and little progress was made except by a few scientists regarding the life and food of plants and how the soil produces crops. The fact that the operations taking place in the ground and in the air are chemical processses of the most intricate kind can readily serve as an excuse that the details thereof were not found out by the farmer but by the chemist in his laboratory. The great principle in chemistry that no atom of matter can either be created or destroyed has its particular application in practical agriculture, calling attention to the fact that every pound of crop taken from the soil leaves that soil that much poorer, further that different crops require different ingredients for their formation, which teaches that although a soil may not be able to produce one kind of crop it still may be capable to produce some other crop of which it contains the raw materials. This also implies the useful principle of crop rotation, whereby a soil brings forth different crops in succession without being impoverished, to all appearances. Furthermore, with the founding of so many agricultural experiment stations the farmer may even go so far as to send a sample of the soil in which he wants to raise a certain crop to the nearest agricultural experiment station for analysis, and after a chemical test he will be informed for what crop the soil is best suited, and also what kind and quantity of fertilizer will be required to add to the soil to produce a certain crop.

Such scientific methods have also been extended to the raising and taking care of all kinds of farm animals, so that today the well-informed farmer is getting more for his labor and investment than ever before, and the new conditions have clearly revolutionized farming, so that the farmers of fifty years ago would be utterly out of place today in the modern applied agriculture.

But this is not all. Some of the greatest wonders have been wrought by the scientific application of water to the deserts, making them bring forth abundant crops, thus reclaiming millions of acres furnishing homes for hundreds of thousands of happy families and adding to the general welfare and wealth of the nations. In this way irrigation has been and still is a mighty force in this world, transforming barren and arid countries into lands of plenty, peace and happiness.

An Oversight in July Issue Corrected. Through an oversight we failed to give credit to *Shop Notes Quarterly* for the splendid article which appeared in our July issue, entitled "Electricity on the Farm," and which through the kindness of the above named publication we were enabled to present to our readers.

Shop Notes Quarterly, which is published by the Popular Mechanics Company of Chicago, is a wide-awake journal, and those who want up-to-date information along mechanical lines will do well to subscribe for it.

Cuba Wants to Be Benefitted by Irrigation. That our neighbors in the West Indies are also waking up to the possibilities and necessities of irrigation is evidenced by the fact that the Cuban government has appointed a commission of consulting engineers to formulate plans for an irrigation system in the province of Piñar del Rio. The commission consists of one American, one Cuban and one English engineer, and Mr. D. C. Henny, consulting engineer of the United States Reclamation Service, stationed at Portland, Oregon, is the American engineer appointed by the Cuban Secretary of Agriculture.

It shows that the Cuban government is embarking upon a truly beneficial mission and it will lose nothing by it, even though it follows the example of the United States government. This move on the part of the Minister of Agriculture shows better than anything else could the progressive policy of the present administration in the republic of Cuba, and is a splendid guarantee of permanent peace and prosperity for that country.

In this connection it may be stated that many other countries are also developing their dormant agricultural resources by investigating the irrigation possibilities within their domain. Among them Mexico, Canada and the Philippine islands are particularly of interest to us. Much new development may be looked for in these countries during the next four or five years.

An Innovation Which Promises Good Results.

The state of Colorado appears to have taken the lead in a move to advance the interests of Irrigation to a considerable degree by the legislature appropriating $10,000 for experimental work and investigation in irrigation and drainage. Although this appropriation was later on cut to $5,800 by the governor to bring it within the revenues of the state, it marks the beginning of a new era in the development of irrigation and drainage, as this $5,800 will prove to be an entering wedge, which is sure to be followed by more and greater appropriations in the future. And another fact should be noted here in this connection which is that the federal government is highly in favor of such a policy and has agreed to add $5,800 of the government funds to supplement the state appropriation. Thus state and federal government go hand in hand to develop the resources of the state along scientific lines, as it ought to be done.

The work will undoubtedly be under the direction of the Colorado Agricultural College and will embrace investigations as to how best apply water for the growing of various crops and comparing various systems with each other; also the determination of the best time to irrigate crops on different soils and the amount of water necessary for the best results; the subject of pumping plants for irrigation purposes; best form of flumes, ditches, pipes, etc., to carry the water will also be duly considered.

What Colorado is doing now should be done by all other states having problems of irrigation and drainage, and that means that practically every state in the union should take action to begin systematic work in the development of its agricultural resources, either in conjunction with or independent of the national government. The problems involved are nation-wide and of sufficient importance to have Congress enact a law to have the federal government give aid, both scientific and financial, to all states that are making progress in solving their agricultural problems on modern and scientific lines.

Rain and Auxiliary Irrigation.

Crop failures by drought in many states where the rainfall is supposed to be sufficient to raise abundant crops is making the affected farmers think of means to help out by irrigation when the rain fails to arrive in time. Many farmers on the Atlantic coast in Maryland and Delaware are investigating the possibilities of irrigation to supplement the rainfall and thus insure themselves against crop losses due to a deficiency in rainfall.

This principle of irrigation in the rain-belt is by no means new but has proven to be highly profitable in almost every instance where it was tried. The progressive, up-to-date farmer will no longer entirely depend upon the rain for the growing of his crops if he has any means at hand whereby he can irrigate his fields—and there are few farms so situated as to have no means for some irrigation as a windmill and pump can be made to do sprinkling duty on most any farm. Small reservoirs built at the higher part of the land with piping and sprinkler attachment would help out wonderfully in a very dry spell and turn the water into money at the harvest time.

THE IRRIGATION AGE reaches irrigators all over the world, but 90 per cent of its readers are residents of the United States. Manufacturers of irrigation and farm appliances will do well to consider this fact when placing advertisements.

The Financial Situation Should be Watched.

Elsewhere appears another forcible letter by Mr. O'Neill bearing upon the subject and should be thoroughly and carefully considered by our readers. The very idea of a banking trust is repugnant to the fair play loving American citizen and any attempt for the formation of such a trust should be combated to the bitter end.

Whether Wall street will be able to dictate the financial policy of the country much longer, after the real wealth of the country is centered in the west is a question which the observant mind doubts very much. The establishment of postal savings bank, while by no means a perfect or even satisfactory measure is, however, an entering wedge which by judicious amendments and extensions should form an impassible barrier for a financial trust such as Mr. O'Neill describes.

It is, however, necessary to watch developments and in doing so Mr. O'Neill is performing a valuable service to the entire country.

Thoughts That Come and Go.

And now Paradise is to be reclaimed and reconverted into a paradise by the Turkish government by irrigating a 600,000-acre tract between the rivers Tigris and Euphrates in Mesopotamia.

* * *

A year's subscription to THE IRRIGATION AGE costs but one dollar; the cost of the "Primer of Hydraulics" is $2.50, and the combined cost of book and journal is $3.00. The "Primer of Hydraulics" is the only book giving a scientific treatise on hydraulics intended for plain people without a college education.

* * *

The Madero government in Mexico is evidently trying to make good and is making plans for a national irrigation propaganda. There is nothing that will make a nation more patriotic than prosperity and peace, and if the Madero government carries out its plans the happiness of Mexico will become an established fact.

* * *

The irrigator, like any other mortal, must learn many lessons by experience, but those he learns from the experiences of others don't cost him anything. Moral: Read THE IRRIGATION AGE and write us your experience for publication, so as to help the other fellow.

* * *

Water may be wasted in many ways, but it cannot be destroyed; much of what is called wasted water does duty in various ways, such as in springs and wells, and much of it comes back in the form of rain and dew to refresh and nourish nature.

* * *

Next to a fully irrigated ranch, with its full quota of accessories, comes a good road to enable the irrigator to take his produce to market. A highway in good condition means prosperity and comfort for the community wherein it is located.

* * *

Public highways of today are a distinct improvement over those of a decade ago, yet there is considerable opportunity for further improvement in this direction.

* * *

The "Primer of Hydraulics" will be ready about January 1, 1912. Send in your order now as you renew your subscription to THE IRRIGATION AGE and save fifty cents by so doing.

Geology and Water Resources of the San Luis Valley, Colorado*

By C. E. Siebenthal

Springs.

The valley affords numerous springs, both large and small. These, with a few exceptions, emerge near the junction of the foothills and the valley bottom. They have mostly the normal temperatures of the shallow artesian waters of the valley, but two springs in the north end of the valley and one near the south end have rather warm temperatures.

The largest group of springs in the valley is that formerly known as Los Ojos, or commonly as McIntire's springs, on the south side of Conejos river. These springs rise in the bottom just at the foot of one of the San Luis hills, and some of the springs appear to come up through crevices in the lava. The group is limited to an area not more than 300 feet in diameter, and they all merge into one stream. The flow from these springs, which is practically constant and does not vary with rainfall, has been measured many times and is found to be about 21 second-feet. The temperature of the stream comprising the united flow of the springs is 60°. Some of the smaller springs have a temperature of 54°, but most of the individual springs are either just over or just under 60°. As these springs rise against or even through comparatively recent lava rocks, their temperature is not a reliable clue to the depth from which they come.

The flow of these springs was filed upon at an early date by the inhabitants of the Mexican village of Los Sauces for irrigation purposes, for which its temperature makes it peculiarly valuable in the early season.

Other Springs Along Conejos River.—Other smaller springs emerge near the base of the San Luis hills along Conejos river from a point near its mouth up to the vicinity of Manassa, as was noted previously, where the supposition was advanced that the water of these springs rises from the water-bearing beds of the Alamosa formation, where they abut against the lava of the Santa Fe formation of the San Luis hills.

Spring Creek.—Spring creek has its head in sec. 12, t. 37 n., r. 7 e., half a mile west of the Gunbarrel road and just under the rise of the steeper alluvial slope. Water rises over an area 15 by 40 feet, flowing more than a cubic foot a second. It is augmented by seepage until at the point where it crosses the Gunbarrel road it has a volume of several second-feet. The flow is affected by melting snows in the mountains. It has a temperature of 57°.

Russell Springs.—Russell springs are situated in the ne. ¼ sec. 24, t. 43 n., r. 7 e. These springs rise in a grassy area 40 acres or so in extent, underlain by a peaty black mud. In this area about twenty-five springs display temperatures ranging from 44° to 56°. The temperature where the water crosses the Gunbarrel road is about 52°. The water has no taste. The water from these springs drains eastward 2 miles into Russell lakes.

Hunt Springs.—Hunt springs are in the ne. ¼ sec. 3, t. 44 n., r. 8 e., at the foot of the small lava hill 4 miles east of Saguache.

By far the greater number of wells in the San Luis basin are along its western slope. Various factors have contributed to this segregation. The principal one, perhaps, has been the presence of greater irrigation systems on that side of the valley and consequent greater population; but another important cause is the fact that the slight inclination of the strata on that side of the valley has made the matter of obtaining an artesian flow much simpler, involving less chances of failure and less expense.

Seasonal Variations.—Near the margin of the area of flowing wells there is a decided periodical variation in pressure or head. Just on the limiting line there are a number of wells that flow during a certain portion of the year and have to be pumped during the remainder of it. The variation in head in these wells is not accurately determined but is about 4 feet. The same variation affects wells within the limits of the flowing-well area, but it there shows itself as a slightly increased or decreased flow, and is not so manifest as in wells along the critical line. These wells, with the seasonal intermissions, flow during the summer and fall and do not flow for the rest of the year. As this is the season of irrigation the flow of the wells is popularly said to "come up with the sub." (that is, with the rise of the water table due to subirrigation); and this is probably true, though of course there is no direct connection of the ditch water with the aquifer. The water in the water-carrying stratum is under constant hydrostatic pressure, tending to rise to the surface and pressing upward always against the confining clay bed above. Any increase of weight upon this clay bed is transmitted downward to the aquifer, which, being thus under greater pressure, yields greater flows than before. The water which is put upon the ground in irrigation adds a very definite increment to the pressure upon the aquifer and it is therefore true that the flow rises with the ditch water. Likewise, the rainfall during the showery season adds to the general pressure and helps to increase the head. The seasonal fluctuation due to irrigation is hence closely allied in principle to the tidal fluctuations in artesian wells at the seashore.

Gradual Failure of Wells.—Several factors contribute to cause the gradual failure of wells. Among these one of the most obvious is the growth of a green alga. This lines the inside of a vertical pipe down for a foot or so, probably as far as light is efficacious, and by its continued growth often constricts the opening so that the water is forced to a height; and the considerable pressure thus exerted on the well doubtless to an appreciable extent reduces its flow.

Another possible cause of the gradual failure of wells is a reduction of the porosity of the sand bed through which the water comes to the bottom of the well. This has been popularly expressed as a "silting up of the water bed." It seems more reasonable to suppose that the free silica, in which the analyses show the water to be especially high, is by the reduction of pressure at the bottom of the well in part precipitated about the grains of sand in the aquifer adjacent to the bottom of the well, which tends to seal the interstices and to reduce the porosity of the bed. For most of their long journey through the beds of granitic and volcanic sand the artesian waters are undoubtedly augmenting their silica content, as shown by the fact that the silicic acid in water from the Rio Grande at Del Norte is 24 parts per million, whereas that of various wells in the San Luis valley ranges from 38 to 106 parts per million. But this fact is not in any way inconsistent with the theory that some precipitation of silica may take place as the waters pass from the sands and gravels of the aquifer to the opening at the bottom of the well tube. Decisive proof of this deposition of silica would be had if secondarily enlarged grains of sand should be brought up in cleaning out some old well that had slowly failed. The writer, though repeatedly trying, has as yet failed to obtain such material with which to test the theory.

But presumably the greater number of cases of gradual failure of wells are due to the increase in number beyond the capacity of the aquifer to furnish the full flow for each. The minimum distance from one another at which wells may be put down without affecting the common flow is difficult to determine and depends on the size of the bore, the capacity of the aquifer, and the artesian pressure. It has been shown that the wells in the town of Monte Vista so seriously affect one another that they have ordinarily a uniform flow. The distance there between the wells is from 50 to 200 feet. A mile northwest of La Jara, on William Lambert's place, of two wells 150 feet apart the newer well seriously affected the flow of the old well. It is noticed in all the towns of the valley that the flows now obtained are not so strong as the flows formerly obtained at the same depth, though the adjacent wells may not seem tot be affected by the sinking of a new well. The normal flow of wells in towns is often so concealed by the piping or restricted by partial use only that it might be seriously impaired without the fact becoming apparent. Such a failure, of course, may be due in part to other causes, but it is undoubtedly due mainly to the increase of wells. It seems certain that the large wells may be placed as close as 440 yards, and reasonably sure that they may be as close as 220 yards, without affecting one another. Smaller wells can, of course, be placed still closer without mutual injury. If it is desired to have two or more large wells close together,

*Abstract from Water Supply paper No. 240 of the United States Geological Survey.

in order that the combined flow may be used for irrigation or stored in a reservoir, they may be so placed if they are bored to different flows and all but the lower flow is cased off from the deeper well. In this way there will be no interference. Instead of sinking two separate wells of different depths, the same effect may be gained by reducing the bore of a large well and continuing it to lower flows, the water from the deeper flows coming up through the smaller inside casing. However, separate wells will in general be preferable, owing to the difficulty of cleaning and repairing multiple wells.

By far the greater number of wells, as will be seen later, are cased only to the first solid clay, a depth varying ordinarily from 10 to 40 or 50 feet. The bore is continued through the various water-bearing beds until a suitable flow is reached. As long as this deeper flow of higher pressure continues the water from the upper water beds will not come into the bore and there will be no mingling of the different flows; but if the well is plugged or is choked near the top, the lower flows, which are under greater pressure, will spread out in the upper beds that are under less pressure, so that the pressure tends to be equalized in the upper and lower flows, and as a result the pressure and consequently the yield of the lower flows are weakened. This process has taken place to such an extent toward the center of the town of Monte Vista that the yield from the various flows is identical, and likewise the temperature.

Sudden Failure of Wells.—In almost all cases sudden failure is due to the caving away of the clay walls of the well. In a well that is not cased the caving in of the clay anywhere along the bore may shut off the water from below the caved place. In a well that is cased to the sand bed furnishing the flow ordinarly there is a rather large cavity in the sand at the bottom of the casing, resulting from the sand being carried up and thrown out of the well. Occasionally large pieces of the clay bed above may tumble into this cavity and clog the bottom of the casing. In the vicinity of Hooper, and northward on the Kinney ranch, the practice is to let the 1-inch pipe that serves as a drill rod remain in the well after completion. This rod, projecting downward below the casing and into the cavity at the base of the well, ordinarily prevents the complete closure of the well by any falling chunks of clay.

Irregularities in Flows from the Same Aquifer.—Adjacent wells that strike the same water bed may have very different flows. These irregularities are probably to be explained by the irregularities in thickness or porosity of the water-bearing bed. The rate at which water passes through sand varies with the size of the sand particles, being greater for the coarser varieties. For this reason the gravel flow obtained in certain parts of the valley is a very free, strong flow. Local variations in the same bed of sand therefore exert a very definite effect upon the quantity of flow.

As the rate of flow through sand of a given size is fixed, the volume of flow from any bed of sand of that size depends on the thickness of the bed. It is not to be presumed that the beds of sand in the valley, though known to be of great extent and persistence, are of the same thickness throughout. Any formation built up more or less in delta form, as are the deposits of the Rio Grande alluvial fan, must of necessity differ in thickness from place to place, and such differences are undoubtedly ample to account for any variations in flow from the same bed.

Variation in Temperature.

The vertical range in temperature observed in the wells of the valley is from a minimum of 45° in shallow wells to a maximum of 75° for the Bucher well at Alamosa. The increase of temperature with depth is very regular; estimated from the deep cased wells near Alamosa it is 1° for 28½ feet.

The minimum temperature is found in wells on the low ground near the Rio Grande north of Monte Vista. Southward along the Gunbarrel road and southeastward along the flowing-well limit to the vicinity of La Jara the shallowest wells have temperatures of about 46°. Southeast of La Jara along Conejos river the shallowest wells have temperatures of 50° to 52°. North of Monte Vista along the Gunbarrel road the temperature of the first flow likewise increases and in the vicinity of Center it is about 51° or 52°. Further north, in the Veteran neighborhood, the temperature is lower again, 46° and 47° in wells reaching the first flows. These temperatures continue to the vicinity of Russell springs, but from there to Swede Corners, 2½ miles north, there is an increase in temperature of 10° in wells of practically the same depth. On the east side of the basin the temperatures are very regular and such as would normally be expected, that is to say, 46° and 47° for the first flow.

It is noticeable that the wells of lowest temperature on the west side of the valley are near the courses of the larger streams and that the higher temperatures are found in the interstream areas. The waters of these streams, derived from melting snow for a large part of the year, are notably cold.

This local excessive cooling of the upper strata of the earth is apparently the explanation of the high temperature gradient of 1° for 28½ feet as compared with 1° for 50 or 60 feet, the average increase as found in deep dry wells, shafts and mines.

The wells with higher temperatures about Swede Corners and along the lower course of the Conejos, with adjacent areas of lava, in all probability derive their excess of heat from subterranean bodies of uncooled igneous rocks.

Uses of the Water.

The principal use of the artesian water is for household purposes, and most of the houses, even on many of the remote ranches, have running water piped into the kitchen and bathroom. Some wells, particularly in Monte Vista, which have not sufficient head to force water into the houses, yet flow freely at the ground level, are used to operate hydraulic rams, which throw a smaller stream to the desired height.

The artesian water is also especially desirable for stock purposes because of its moderate and constant temperature, which is high enough so that the wells remain open in winter; because of its continuity of supply without pumping or other care; and because of its freedom from contamination. Wells are bored here and there over the stock ranges in the valley by private persons or by neighborhood associations.

The waste flow from the household wells is either run into irrigating ditches or is used for the irrigation of gardens and truck patches. In the town lawns, gardens and shade trees are irrigated from the overflow of the wells. The surplus not so used runs into the gutters and is ordinarily collected into a ditch outside the town and used for field irrigation.

In certain sections of the valley the artesion water is an essential factor in irrigation. These regions are largely confined to the west side of the valley, where the west side of any tract is the higher. Areas where many wells have been sunk for this purpose are (1) the region between Henry station and Bowen schoolhouse; (2) along Rock creek; (3) in the neighborhood of Veteran schoolhouse; and (4) in the Warner neighborhood. In the first of these localities the wells were sunk for the purpose of irrigating grain, but in the last three chiefly for the purpose of irrigating native hay. Native meadows, since they are not cultivated from year to year, have many little irregularities and hummocks which can not be irrigated from ditches. It is customary to irrigate such places, if of sufficient area, by a well sunk on the highest point.

In the Veteran and Warner neighborhoods the wells are used to irrigate both grain and hay, and their development was largely the result of the failure of ditch water. For the same reason many wells have been sunk toward the center of the valley in the Hooper and Mosca districts, where the supply of ditch water has been very inadequate in recent years. A recent development of the use of wells for irrigation is the constructon of about fifty 6-inch wells in the vicinity of Henry station and westward as far as the Fountain neighborhood. These in general have been very successful.

The average well, if allowed to flow continuously, undisturbed. will wet an area of not more than one-half acre around the mouth of the well. The greater number of wells are used simply to supplement the flow in the ditches. The supply of ditch water early in the season is always sufficient to raise the "sub." Then, later in the season, when the ditch water fails, the ground being already wet, the steady flow of artesian wells is of great value. Where wells are not to be used in connection with the ditch water a reservoir is a necessity, unless they are very large. In many parts of the valley, owing to the loose texture of the soil, reservoirs will absorb the entire flow of a well for a year before holding water. It is suggested that it would be a good plan to construct reser-

voirs in the fall and turn in the muddy flood water from the ditch until the bottom of the reservoir is thoroughly wetted and silted up.

It is hard to make a just estimate of the extent of the use of artesian water in irrigation, first, because of the fact, before stated, that the water is in many places turned into the ditches to supplement the ditch flow, and, second, because there is a tendency in the valley to underrate the extent of such use, lest an optimistic estimate should unfavorably affect desired legislation for storage reservoirs in the mountains, It is realized locally that further agricultural expansion depends on the construction of reservoirs to conserve the flood waters, and there is a concerted movement in that direction.

With a few exceptions the wells of the valley have been sunk by the hydraulic jet process. The exceptions are those which have been drilled through lava, mostly nonflowing wells. The deepest well in the valley, the No. 1 well of the San Luis Oil Company, 1,283 feet deep, was sunk by the hydraulic process, as were many others that reach 1,000 feet or more in depth. The individual drillers have their favorite forms of bits, and their own methods of "rotating" or "driving" the casing, but the general method of sinking is the same here as elsewhere.

When the well has been sunk into the desired aquifer and the flow is reached, the pump is kept going for some time, a day or more in deep wells, with the object of stirring up the sand and carrying it up the well bore until a considerable cavity is made at the bottom of the well. Water can be delivered to the well only so fast as it can come through the sand walls of the cavity at the bottom of the well. The

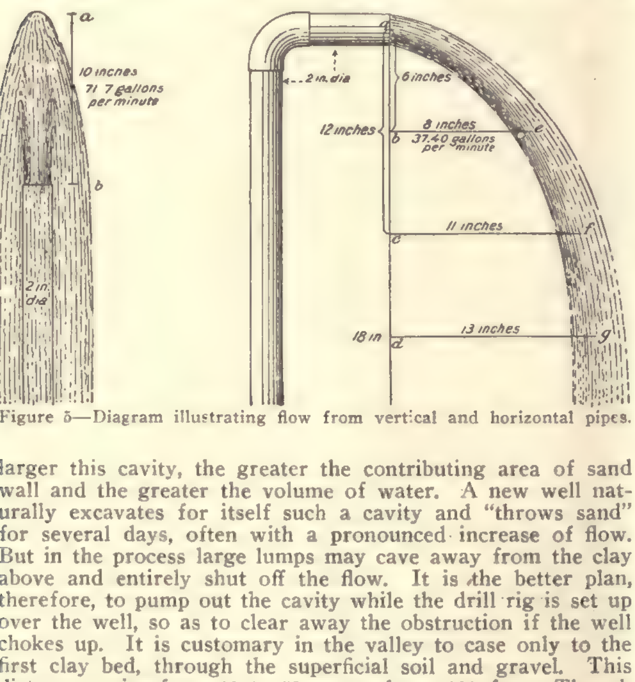


Figure 5—Diagram illustrating flow from vertical and horizontal pipes.

larger this cavity, the greater the contributing area of sand wall and the greater the volume of water. A new well naturally excavates for itself such a cavity and "throws sand" for several days, often with a pronounced increase of flow. But in the process large lumps may cave away from the clay above and entirely shut off the flow. It is the better plan, therefore, to pump out the cavity while the drill rig is set up over the well, so as to clear away the obstruction if the well chokes up. It is customary in the valley to case only to the first clay bed, through the superficial soil and gravel. This distance varies from 10 to 50 or rarely to 100 feet. Though inevitable, this practice of partial casing is much to be deplored.

Owing to the high freight rates, the item of casing in an average well costs more than the drilling. As long as a new well can be put down for the cost of casing the first one, most people of moderate means, at least in districts where the clay resists the cavity fairly well, will prefer to take chances on the caving of the uncased well, especially where the wells are drilled for irrigation purposes as a last resort after successive failures of the ditch water and when immediate results are needed. Many wells, however, are cased down to the main flow that is used. The flow of such a well is affected only by increase in the number of wells, and can be shut off in winter time with impunity, whereas the uncased well is quite likely to cave within a year or so, particularly if plugged in winter. A large percentage of the wells in the valley have fallen off one-half or more in flow, principally through caving in. If caving takes place as a result of plugging the well, it usually happens when the plug is removed. While the well is open the rapid ascent of the water tends to carry to the surface and clear the well of any caved material as fast as it falls. When the well is plugged, however, the water in the bore and to a certain extent in the different aquifers assumes a uniform pressure. This uniformity of pressure has a tendency to favor the disintegration of the walls of the bore. The material breaking away settles downward through the still water in the bore and packs itself in the bottom, When the well is turned on again the amount of material packed in the bottom may be suffcient to cut off the lower flow. Again, the sudden shock of decrease of pressure when the well is suddenly opened by knocking out the plug has likewise a tendency to jar off pieces of the clay wall.

The cost of boring wells, owing to the similarity of the formations, is nearly uniform for similar sizes over the valley. The price of the completed well varies of course with the diameter and depth of the bore hole and the size and length of the casing. The price of casing also varies materially from time to time. The following statement gives the cost of a few typical wells in Alamosa, and the cost of others has been given in preceding pages.

Cost of typical wells in Alamosa.

Two-inch wells:	
280 feet deep, cased about 50 feet	$ 55
460 feet, cased about 50 feet	101
600 feet deep, cased about 50 feet	135
735 feet deep, cased to the bottom	351
Three-inch wells:	
650 feet deep, cased about 50 feet	145
730 feet deep, cased about 50 feet	161
Town well, 5⅝ inches in diameter:	
865 feet deep, cased to 852 feet	1,865

Approximate Measurement of Flowing Wells.

Tables for determining the discharge of water from completely filled vertical and horizontal pipes were prepared a number of years ago by Prof. J. E. Todd, state geologist of South Dakota, who issued a private bulletin describing simple methods of determining quickly, with fair accuracy and with little trouble, the yield of artesian wells. The following tables and explanations relating to vertical and horizontal pipes are taken from this bulletin, with extensions by the present writer. The explanations and tables relating to the measurement in the partly filled horizontal and inclined pipes are from a paper by Charles S. Slichter.

In determining the flow of water discharged through a pipe of uniform diameter all that is necessary is a foot rule, still air, and care in taking measurements. Two methods are proposed, one for pipes discharging vertically, which is particularly applicable before the well is permanently finished, and one for horizontal discharge, which is the most usual way of finishing a well.

The table No. 1 at the end of this article is adapted to wells of moderate size as well as to large wells. If the well is of a diameter not given in the table its discharge can without much difficulty be obtained from the table by remembering that, other things being equal, the discharge varies as the square of the diameter of the pipe. If, for example, the pipe is one-half inch in diameter its discharge will be one-fourth of that of a pipe 1 inch in diameter for a stream of the same height. In a similar manner the discharge of a pipe 8 inches in diameter can be obtained by multiplying the discharge of the 4-inch pipe by 4.

In the first method the inside diameter of the pipe should first be measured, then the distance from the end of the pipe to the highest point of the dome of the water above, in a strictly vertical directon—*a* to *b* in the diagram (Fig. 5). Find these distances in Table 1; the corresponding figure gives the number of gallons discharged each minute. Wind would not interfere in this case, if only the measurements are taken vertically.

The method for determining the discharge of horizontal pipes requires a little more care. First measure the diameter of the pipe as before; then from a point (*b*, Fig. 5) 6 inches vertically below the center of the opening of the pipe, or some convenient point corresponding to it on the side of the pipe (*a*), measure strictly horizontally to the center of the stream (*b* to *e*). With these data the flow in gallons per minute can be obtained from Table 2. It will readily be seen that a slight error may make much difference in the result. Care must be taken to measure horizontally and also to the center of the stream. Because of this difficulty it is desirable to check the first determination by a second. For this purpose columns are given in the tables for corresponding measurements from a point 12 inches below the center of the pipe. Of course the same result should be obtained in the two measurements of the same stream. Wind blowing either with or against the

water may vitiate results to an indefinite amount; therefore measurements should be taken while the air is still.

Whenever fractions occur in the height or horizontal distance of the stream the number of gallons can be obtained by apportioning the difference between the readings in the table for the nearest whole numbers, according to the size of the fraction. For example, if the distance from the top of the pipe to the top of the stream in the first case is 9⅓ inches, one-third of the difference between the reading in the table for 9 and 10 inches must be added to the former to give the correct result.

One might suppose that when the flow of a well is measured by both methods the results should agree, but this is not the fact. In the vertical discharge there is less friction, and the flow is larger; so also in the second method differences will be found according to the length of the horizontal pipe used.

As pipes are occasionally set at an angle, it is well to know that the second method can be applied to them if the first measurement is taken strictly vertically from the center of the opening, and the second measurement from that point parallel with the axis of the pipe to the center of the stream, as before. The rates of flow in Table 2 are then applicable.

These tables are based upon a well-known formula of hydraulics. Experiment has shown that a margin of error is involved in the estimates when the height of the jet is less than 2 feet—that in such results there is 5 to 20 per cent or more of excess, which is greater the smaller the pipes and the lower the jets. But these are just the flows that can be most easily measured in a vessel of known size, and this method should always be resorted to when possible. The greater number of the larger wells flow from vertical pipes. Such a pipe may be so close to the ground that the water cannot be caught in a receptacle; and not uncommonly it is surrounded by a reservoir, designedly or otherwise, so that it is convenient to measure by means of a vessel. For measuring the flow of such wells the tables will be found very convenient.

To convert gallons into cubic feet, divide by 7.5, or, more accurately, by 7.48.

A second-foot equals a flow of 448.8 gallons a minute, or 38.4 Colorado miner's inches. A flow of 100 Colorado miner's inches equals 2.6 second-feet. A flow of 100 Colorado miner's inches equals 1,170 gallons a minute; 1 Colorado miner's inch equals 11.7 gallons a minute.

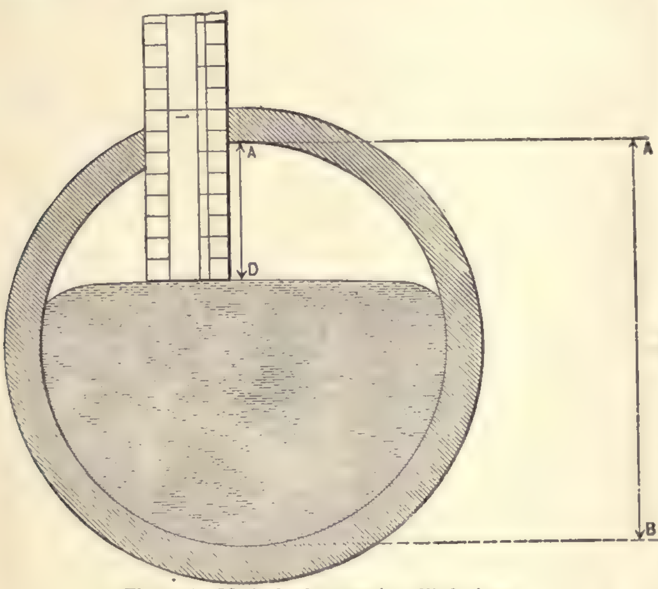


Figure 6—Method of measuring filled pipes.

Measurement of Flows from Partly Filled Pipes.

From Table 3 below it should be possible, if the wind is not blowing too hard, to determine the flow from a partly filled pipe with an error probably not exceeding 10 per cent. This error is no greater than the fluctuation of the flow due to the daily variations of the barometric pressure in most wells. The results in extreme cases, such as a ¼-inch stream in a 6-inch pipe are, of course, still less accurate, and actual measurement by collecting the water in a vessel of definite capacity should be resorted to if possible.

To estimate the discharge from a partly filled horizontal or sloping pipe, first estimate the discharge from full pipe of the same size by means of Table 2.

Next measure with a foot rule the dimension A D (Fig. 15) of the empty portion of the cross section of the pipe. Divide this by the inside diameter of the pipe, which will give the fractional part of the diameter that is occupied by the empty part of the pipe. In Table 3 find in the first column the number nearest to the above quotient. Opposite this number will be found the percentage of the discharge of the full pipe that the partly filled pipe is yielding. It is sufficient to measure the distance A D to the nearest eighth of an inch, or at most to the nearest sixteenth of an inch.

Suppose that a 2-inch horizontal pipe has a length of jet of 13 inches at 6-inch level. From Table 2 this would represent a discharge of 60 gallons per minute from the full pipe. Suppose that the distance A D is five-eighths of an inch and A B is 2 inches, or sixteen-eighths of an inch. Dividing 5 by 16 gives 0.31. In the first column of Table 3 we find 0.30, the nearest to 0.31, and opposite 0.30 in the second column of the table appears 0.75. The discharge from the partly filled pipe is therefore $60 \times 0.75 = 45$ gallons per minute.

TABLE 1.—*For determining yield of artesian wells flowing from vertical pipes.*

[Gallons per minute.]

Height of jet.	Yield from pipe with diameter of— 1 inch.	2 inches.	3 inches.	4 inches.	5 inches.	6 inches.
Inches.						
1/8	1.90	6.7	15.2	29.4	47.2	60.8
1/4	2.80	10.7	24.0	43.0	69.2	96.0
3/8	3.43	13.6	30.4	54.0	85.5	121.6
1/2	3.96	15.8	35.6	63.2	98.8	142.4
5/8	4.42	17.8	40.2	71.0	110.8	160.8
3/4	4.85	19.5	44.3	78.0	121.6	177.2
7/8	5.24	21.1	48.0	84.1	130.5	192.0
1	5.60	22.4	51.4	89.6	140.0	205.6
1 1/4	6.29	25.2	57.4	100.5	156.8	229.6
1 1/2	6.90	27.6	62.6	110.2	171.6	250.4
1 3/4	7.45	29.9	67.5	119.4	186.3	270.0
2	7.99	32.0	71.9	128.0	200.0	287.6
3	9.81	39.2	88.3	146.8	245.0	353.2
4	11.33	45.3	102.0	181.2	283.1	408.0
5	12.68	50.7	113.8	202.8	316.9	455.2
6	13.88	55.5	124.9	222.0	346.9	499.6
7	14.96	59.8	134.9	239.2	373.8	539.6
8	16.00	64.0	144.1	256.0	400.0	576.4
9	17.01	68.0	153.1	272.0	425.0	612.4
10	17.93	71.6	161.3	286.4	447.5	645.2
11	18.80	75.2	169.3	300.8	470.0	677.2
12	19.65	78.6	176.9	314.4	491.3	707.6
13	20.46	81.8	184.1	327.2	511.3	736.4
14	21.22	84.9	190.9	339.6	530.6	763.6
15	21.95	87.8	197.5	351.2	548.8	790.0
16	22.67	90.7	203.9	362.8	566.9	815.6
17	23.37	93.5	210.3	374.0	584.4	841.2
18	24.06	96.2	216.5	384.8	601.3	866.0
19	24.72	98.9	222.5	395.6	618.1	890.0
20	25.37	101.6	228.5	406.4	635.0	914.0
21	26.02	104.2	234.3	416.8	651.3	937.2
22	26.66	106.7	240.0	426.8	666.9	960.0
23	27.28	109.2	245.6	436.8	682.5	482.4
24	27.90	111.6	251.1	446.4	697.5	1,004.4
25	28.49	114.0	256.4	456.0	715.5	1,025.6
26	29.05	116.2	261.4	464.8	726.3	1,045.6
27	29.59	118.2	266.1	472.8	738.8	1,064.4
28	30.08	120.3	270.4	481.2	751.9	1,081.6
29	30.55	121.9	274.1	487.6	761.9	1,093.4
30	30.94	123.4	277.6	493.6	771.3	1,110.4
36	34.1	136.3	306.6	545.2	851.9	1,226.4
48	39.1	156.5	352.1	626.0	978.1	1,408.4
60	43.8	175.2	394.3	700.8	1,095.0	1,577.2
72	48.2	192.9	434.0	771.6	1,205.6	1,736.0
84	51.9	207.6	467.0	830.4	1,297.5	1,868.0
96	55.6	222.2	500.0	888.8	1,388.8	2,000.0
108	58.9	235.9	530.8	943.6	1,474.4	2,123,2
120	62.2	248.7	559.5	984.8	1,554.4	2,238.0
132	65.1	260.4	585.9	1,041.6	1,627.5	2,343.6
144	68.0	272.2	612.5	1,088.8	1,701.3	2,450.0

TABLE 2.—*For determining yield of artesian wells flowing from horizontal pipes.*

[Gallons per minute.]

Horizontal length of jet.	1-inch pipe. 6-inch level.	1-inch pipe. 12-inch level.	2-inch pipe. 6 inch level.	2-inch pipe. 12-inch level.	3-inch pipe. 6-inch level.	3-inch pipe. 12-inch level.
Inches.						
6	7.01	4.95	27.71	19.63	62.35	44.17
7	8.18	5.77	32.33	22.90	72.74	51.53
8	9.35	6.60	36.94	26.18	83.12	58.91
9	10.51	7.42	41.56	29.45	93.51	66.26
10	11.68	8.25	46.18	32.72	103.91	73.62
11	12.85	9.08	50.80	35.99	114.30	80.98
12	14.02	9.91	55.42	39.26	124.70	88.34
13	15.19	10.73	60.03	42,54	135.07	95.72
14	16.36	11.56	64.65	45.81	145.46	103.07
15	17.53	12.38	69.27	49.08	155.86	110.43

16	18.70	13.21	73,89	52,35	166.25	117.79
17	19.87	14.04	78.51	55.62	176,65	125.15
18	21.04	14.86	83.12	58.90	187.02	132.53
19	22.21	15.69	87.74	62.17	197.42	139.88
20	23.37	16.51	92.36	65.44	207.81	147.24
21	24.54	17.34	96.98	68.71	218.21	154.60
22	25.71	18.17	101.60	71.98	228.60	161.96
23	26.88	18.99	106.21	75.26	238.97	169.34
24	28.04	19.82	110.83	78.53	249.37	176.69
25	29.11	20.64	115.45	81.80	259.76	184.05
26	30.38	21.47	120.07	85.07	270.16	191.41
27	31.55	22.29	124.69	88.34	280.55	193.77
28	32.72	23.12	129.30	91.62	290.93	206.15
29	33.89	23.95	133.92	94.89	301.32	213.50
30	35.06	24.77	138.54	98.16	311.72	220.86
31	36.23	25.59	143.16	101.43	322.11	228.22
32	37.40	26.42	147.78	104.70	332.51	235.58
33	38.57	27.25	152.39	107.98	342.88	242.96
34	39.64	28.08	157.01	111.25	353.27	250.31
35	40.45	28.64	161.63	114.52	363.67	257.67
36	41.60	29.46	166.25	117.79	374.06	265.03
Continue by adding for each inch—	1.15	0.82	4.63	3.27	10.39	7.36

The flow in pipes of diameters not given in the table can easily be obtained in the followng manner:

For ½-inch pipe, multiply discharge of 1-inch pipe by............ 0.25
For ¾-inch pipe, multiply discharge of 1-inch pipe by............ 0.56
For 1¼-inch pipe, multiply discharge of 1-inch pipe by.......... 1.56
For 1½-inch pipe, multiply discharge of 1-inch pipe by............ 2.25
For 3-inch pipe, multiply discharge of 2-inch pipe by.............. 2.25
For 4-inch pipe, multiply discharge of 2-inch pipe by.............. 4.00
For 4½-inch pipe, multiply discharge of 2-inch pipe by............ 5.06
For 5-inch pipe multiply discharge of 2-inch pipe by.............. 6.25
For 6-inch pipe, multiply discharge of 2-inch pipe by.............. 9.00
For 8-inch pipe, multiply discharge of 2-inch pipe by..............16.00

TABLE 3.—*For estimating the discharge from partly filled horizontal or sloping pipes.*

Fractional part of diameter of pipe not occupied by water. [Obtained by dividing A D by A B in fig. 1]	Discharge expressed as percentage of discharge from full pipe, same size.	Fractional part of diameter of pipe not occupied by water. [Obtained by dividing A D by A B in fig. 1.]	Discharge expressed as percentage of discharge from full pipe, same size.
0.05	0.98	0.55	0.44
.10	.95	.60	.37
.15	.91	.65	.31
.20	.86	.70	.25
.25	.80	.75	.20
.30	.75	.80	.14
.35	69	.85	.092
.40	.63	.90	.054
.45	.55	.95	.015
.50	.50	1.00	.000

DRY FARMING IN NEW MEXICO AND TEXAS.

Rain has fallen again over the great upland country of western Texas and eastern New Mexico and after two years of the most persistent drougth even the semi-arid southwest has ever known. Streams are flooding; arroyas and creeks that have been dry for many months are running bank full; the water holes are filled again and the whole region is soaked from the staked plains to the Mexican border. The rains of the past two months have demonstrated again the wonderful drouth resistance of the forage plants and native growth of the far southwest. Three months ago this whole great area was as dry and as brown and bare of virdure as a vast sheet of wrapping paper. Now, as far as the eye can see it is carpeted with grass and flowers and dotted here and there with growing crops. The cattle and sheep growers who have suffered heavy losses during the past two years, are only less jubilant than the thousands of homeseekers and dry farmers who have been clinging to their claims with that marvelous persistence characteristic of the American pioneer. The same indomitable spirit has been manifest in New Mexico during this trying period as was shown during the dark days of western Kansas, and which finally transformed western Kansas from a desert into a thickly populated farming country.

The dry farming regions of west Texas and New Mexico, in fact, are just now going through the same transition period as occurred in Kansas, save for the fact that the disastrous land boom and the subsequent slump which occurred in Kansas, have been lacking in the new drying farming country. It is apparent that in west Texas and New Mexico dry farming has come to stay.

Six years ago a small colony of men, whose friends considered them crazy, undertook to farm without irrigation in the country around Portales, New Mexico, near the Texas border. No one had ever tried to farm any of this land before, but these men reasoned that if native grass would grow knee-high, other forage crops would flourish. They tried it and were astonished at the results obtained. Huge yields were had of milo-maize, kaffir corn and other forage crops. Irish potatoes flourished; their truck patches did well and they even secured half a bale of cotton to the acre. The news spread like wild fire and the next year an army of homeseekers marched into New Mexico. In four years, without advertising or land booming and in the face of persistent prophesies of disaster, 40,000 homestead entries were made, covering over eight million acres of land. The rainfall continued abundant and the homeseekers, entirely ignorant of dry farming methods, of soil preparation, grew their crops as they had done in the rain belt.

Then the long predicted drought came. It found a great majority of the homesteaders without any knowledge of how to conserve the moisture in the soil and their crops burned up or failed to germinate. This condition continued for two seasons. Many of the homesteaders were forced to give up and leave the country, but the large majority, with the persistence of the true pioneer, stuck to their claims and began to learn the scientific methods of moisture conservation known as dry farming. In this they were assisted by experts put in the field by New Mexico and by the various railroads, which placed trained men in the field whose sole duty it was to teach the homesteaders what to plant and when and how to plant it.

The result of two years of study and experiment are apparent this season over the whole southwesern dry-farming region. During the period of drouth the word went out over the country that dry farming in the southwest had failed; just as during the dark days in Kansas, the news went out that western Kansas was an unredeemable desert. Yet during the worst of the drouth the dry farming towns continued to grow and new settlers continued to come in. The new men came with enough money to tide them over a bad season. They were supplied with bundles of books and pamphlets telling them how to farm the land, and the result of the campaign of education was that even in the season of 1910 when the rainfall reached its minimum, the men who followed dry farming principles succeeded with their crops.

In order to determine the exact status of the dry farming industry the New Mexico Bureau of Immigration at Albuquerque, with the assistance of a corps of experts, recently made a dry farming census. This census shows that there are at present 718,000 acres actually under cultivation in New Mexico by dry farming methods, and the conclusion of the experts is that there are 17,300,000 acres in 23 of New Mexico's 26 counties over which the rainfall at normal is sufficient for successful dry farming. These men predict that the time will come when this whole great area will be under cultivation without irrigation. The bulk of this acreage, where dry farming is practical, is public domain, open to entry under the United States land laws. New Mexico has made no effort to encourage immigration into the dry farming districts, prefering to wait until dry farming methods and results had been more thoroughly demonstrated. That the system has survived the past two years of extreme drouth—and survived with nearly three-quarters of a million acres remaining in cultivation, is sufficient proof that much of the so-called southwestern desert is not a desert; that dry farming has come to stay and that it will be the means of furnishing homes to many thousands of the land hungry.

The Secretary of the Interior has authorized the Reclamation Service to establish at an early date the farm units for the Grand Valley Irrigation project in Utah. The total irrigable area in this project is 50,000 acres, of which about 10,000 acres are public land withdrawn from entry. 19,000 acres are land entered under the reclamation act, making a total of about 30,000 acres subject to this act. There are also about 20,000 acres of private lands, of which 15,000 acres are pledged to this project. The work of establishing these farm units will be attended with considerable difficulty, owing to the variation in the soil and climatic conditions.

DAM OF THE TWIN FALLS SALMON RIVER LAND AND WATER COMPANY.

During the month of July the editor of The Irrigation Age made a general trip throughout Colorado, Wyoming, Utah and Idaho, the principal object of the trip being to cover some territory lying under and depending upon the great Salmon River Dam, from which all of the area known as the Salmon River tract will derive its water.

This is one of the most wonderful structures of its kind in the world. We are herewith presenting photographs taken by the constructing engineer, Mr. Horn, which will give some fair idea of its magnitude.

The height of the dam, as shown by the table below, is 229.5 lineal feet and it has a total length on the top of 482 feet, with a thickness at the base of 119 feet and a top thickness of 15 feet. It will be seen by these figures that the dam is no small affair and the estimated cost of the system, including the dam, is something like $2,500,000. The territory to be covered by this water is about 128,000 acres and the cost of the water will be $40 per acre, which is considered a moderate charge when the great cost of construction is considered.

We are also giving here some figures furnished us by D. E. Burley, general passenger agent of the Oregon Short Line Railway, Salt Lake City, Utah, which will give some idea of the various projects under course of construction elsewhere in Idaho. Mr. Burley has a system of compiling and keeping record data concerning all development work in Utah; in fact his office is a mine of information to those who need to secure authentic data about any specific project or group of projects. Those who are looking for information may secure it in comprehensive form by getting in touch with Mr. Burley by mail.

The following information in regard to this dam has been furnished us by Mr. F. C. Horn, construction engineer of the Twin Falls Salmon River Land and Water Co.:

Height of dam ....229.5 lineal feet

View from Cliff at West End, Looking Down on Top. Salmon River Dam, May, 1911.

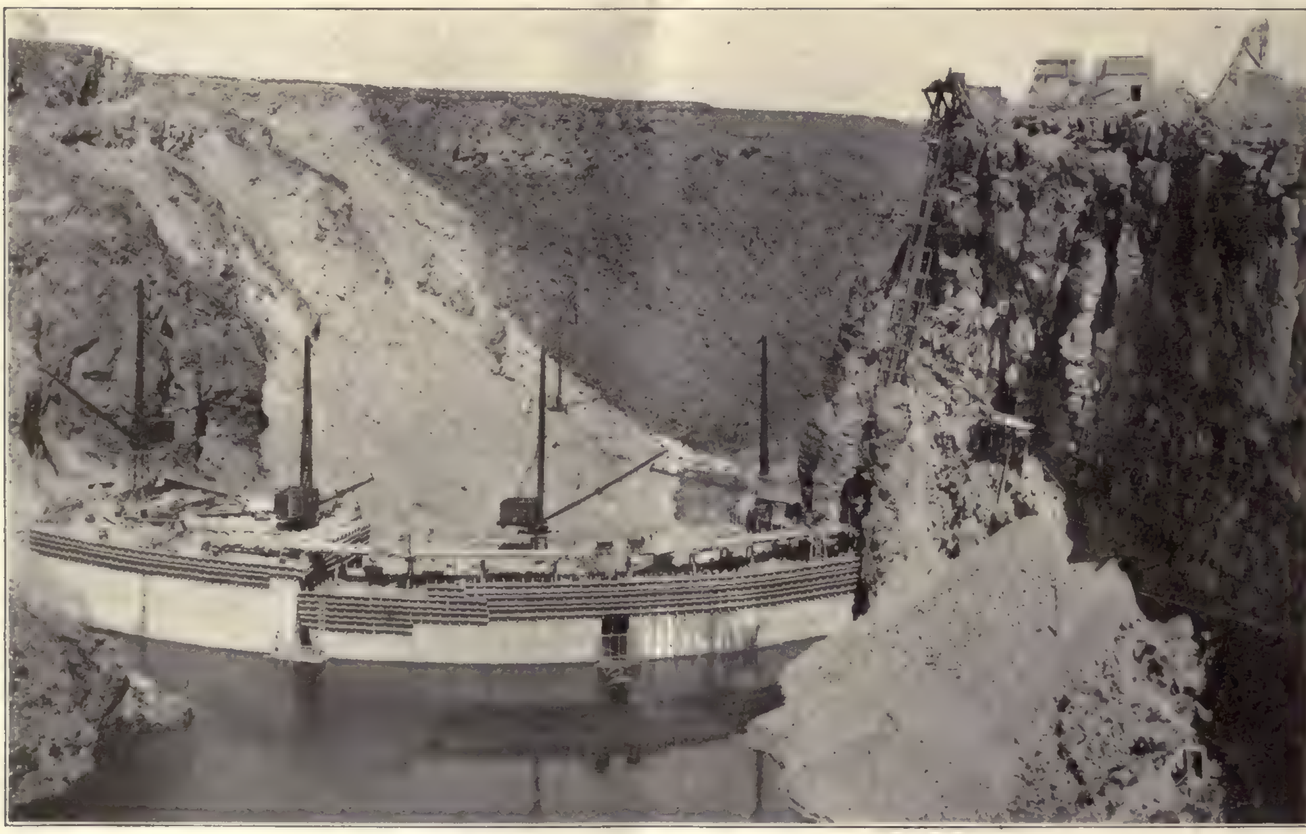
Length of dam on top	482	lineal feet
Length of dam at base	320	lineal feet
Thickness of dam at base	119	lineal feet
Thickness of dam at top	15	lineal feet

Volume of dam, 152,000 cubic yards of cyclopean concrete masonry forming a monolith in the Little Salmon River Canyon.

Length of tunnel leading from reservoir to head of main canal is 3,600 lineal feet and is lined with concrete masonry.

Area of tunnel section is 125 square feet.

Canon Before Any Work Was Done.—Salmon River Dam.



View Down Stream, April, 1910.—Salmon River Dam.

Discharging capacity of tunnel is 1,250 cubic feet per second (562,500 gallons per minute).

Available storage capacity of reservoir, 180,000 acres feet (58,806,000,000 gallons).

Acres under canal system, about 80,000.

Acres entered under Carey act June 1st, 1908, is 72,000.

Length of main canal	11 miles
Length of lateral canals	234 miles
Total	245 miles
Cost of dam and tunnels, approximately	$1,650,000
Cost of canals and canal system, approximately	850,000
Total cost, approximately	$2,500,000

This company controls also the electric water power of Shoshone Falls for pumping plants, which will reclaim an additional 10,000 acres on the north side and 3,700 acres on the south sde.

Location of project, Twin Falls County, Idaho.

Location of headquarters, Twin Falls, Idaho.

Location of dam and reservoir, seven miles southwest of Rogerson.

Source of water supply, Salmon River.

Estimated cost of system, $2,500,000.

Approximate acreage, 128,000.

Cost of water per acre, $40.

Mr. I. B. Perrine, vice-president, Twin Falls, Idaho.

Mr. F. C. Horn, project engineer, Rogerson, Idaho.

Mr. D. E. Burley, general passenger agent of the Oregon Short Line Railroad, Salt Lake City, Utah, adds the following information:

Cost of water per acre, $25 to $50.

Mr. I. W. McConnell, manager, Richfield, Idaho.

Mr. W. L. Gorton, project engineer, Richfield, Idaho.

Kings Hill Irrigation and Power Company.

Gravity.

Location of project, Lincoln, Owyhee and Elmore counties, Idaho.

Location of headquarters, Glenns Ferry, Idaho.

Source of water supply, Malad River.

Estimated cost of system, $520,000.

Approximate acreage, 18,000.

Cost of water per acre, $65.

Extension of the above; same source of water supply:

Estimated cost, $625,000.

Approximate acreage, 9,800.

Cost of water per acre, $65.

Twin Falls-Oakley Land and Water Company.

Reservoir and Gravity.

Location of project, Cassia County, Idaho.

Location of headquarters, Burley, Idaho.

Location of dam and reservoir, five miles north of Oakley, Idaho.

Source of water supply, Goose Creek.

Estimated cost of system, $1,750,000.

Approximate acreage, 44,000.

Cost of water per acre, $65.

Down Stream View, July, 1910.—Salmon River Dam.

Idaho Irrigation Company.

Reservoir and Gravity.

Location of project, Lincoln County, Idaho.

Location of headquarters, Richfield, Idaho.

Location of reservoir, twenty-five miles north and west of Richfield.

Source of water supply, Big Wood River.

Estimated cost of system, $3,500,000.

Approximate acreage, 160,000.

The North Side Twin Falls project is the most important of course on account of the acreage reclaimed, but the Twin Falls-Salmon project would be of much greater interest to the average reader or tourist, on account of its engineering features, and the great dam, which is about 229.5 feet high of solid concrete, being probably one of the highest construction of its character in the world.

The accompanying half tones illustrate the Salmon River Dam and its site in a very thorough and clear manner.

State Against Federal Control of Natural Resources

By F. C. Finkel

Since the verdict of the eastern states in the fall elections it may seem like adding insult to injury to add to the argument against the so-called "New Nationalism." The idea put forward under this title was new in name only, and was quickly recognized as the old and discredited Federalism of our country's early history.

The "New Nationalism" gave its last gap at the "Saratoga Convention," even as the "Old Federalism" did at the "Hartford Convention." The only difference was that this last reincarnation of Federalism was shorter lived than its prototype. The people of the United States have studied history and the majority have not yet forgotten it.

All this hysterical agitation in favor of the Federal government taking charge of the undeveloped natural resources in the different states was the result of what? Merely the desire of certain individuals to create a powerful bureaucracy in this country and thereby to arrogate to themselves almost unlimited power.

It was during the last adminstration of Roosevelt that Gifford Pinchot, then chief forester, matured the plan to make of himself a potentate so powerful that he might to all intents and purposes control the resources of this nation. It was then unnecessary to invent high sounding names like the "New Nationalism"; for Mr. Pinchot's work was then being done quietly and effectively while the people slept in the belief that he was only their faithful servant.

What Col. Roosevelt's exact part in the plan was at that time may never be known. But when President Taft, who is endowed both by nature and education with a deep seated respect for law, checked the ambitious plan of Mr. Pinchot, the ex-president, after his return from Africa, came to the rescue of his former chief forester at the St. Paul Conservation Congress last summer and launched his meteoric and misnamed "New Nationalism." While this may be evidence tending to show that the Pinchot bureaucracy was as much Col. Roosevelt's plan as his own, it is by no means conclusive. We must remember that Col. Roosevelt's very nature tends to draw him to those ideas of government, which demand the increase of autocratic official power. Himself a man who never could consent to have his own power limited, or his ideas modified, what is more natural than that he should come to the rescue of his friend Pinchot, also desiring and striving for personal power?

The opportunity seized upon by Mr. Pinchot for self-aggrandizement was afforded him by the very men and interests now most opposed to him. These men and interests are those who have, since the first settlement of the West, labored industriously and continuously to develop and improve the West and its resources, in many instances profiting financially by their efforts, but invariably benefiting the community at large more than themselves.

These men and interests saw that there was much unnecessary waste and misdirected effort in the development of natural resources, and asked that some means of protection be devised to prevent reckless and wanton waste of natural resources in the western states and territories. The first step taken was the calling of the First National Irrigation Congress, which met at Salt Lake City, Utah, on September 15, 1891. Water is the great essential of the arid west, and prior to 1891 the only important use of water was for irrigating land. The men who represented the West in the First National Irrigation Congress (the writer was one of them) saw the necessity for conserving the water supply in every possible manner. With this idea uppermost in his mind each returned to his own state or territory and took up the work of water conservation. This led to the protection of the forest cover on the mountain drainage areas of streams, and the necessity for wholesome regulations to prevent trespass on the watersheds by men and animals, which would tend to diminish and impair the water supply.

As the lands in these watersheds were mountainous and principally lands belonging to the United States, what was more natural than to ask the United States Government to protect them? This the people of the West did, California taking the lead, and the San Bernardino Forest Reserve (now a part of the Angelus National Forest) was created by President Benjamin F. Harrison at the request of the Arrowhead Reservoir and Power Company of San Bernardino, Cal., in December, 1892. Other forest reserves rapidly followed in different parts of the western states and territories, always created at the request of those who were developing and using the water of streams first for irrigation and later for power, or both combined.

It was never the idea of these pioneers in the work of conservation, that the Federal Government should acquire any right in the waters of the streams which, by law belonged to the people of the different states to be acquired and beneficially used under state laws. Nor was it ever the idea of the national administrations under President Harrison, Cleveland and McKinley, as is proven by all the decisions of the commissioner of the general land offices and secretary of the Interior in cases then arising where rights of way were sought across the national forest reserves for conserving and carrying water for irrigation and power.

It was, of course, necessary to have a department of forestry to manage the different forest reservations, but the original purpose of such a department was merely to see that lumbering and grazing were carried on in a manner which would not impair the watersheds, that reckless trespassing, resulting in forest fires, were prohibited and that rights, easements and permits to occupy lands for developing water, mineral and other natural resources were granted under restrictions and regulations, which would afford correlative protection to all such interests and the forest reserves themselves. In the beginning, while the forestry department was under the secretary of the interior, an old department of the government which has respect for the constitution and law, there was no cause for complaint. Had it not been for the personality of Gifford Pinchot, there is no doubt that it would still have continued to be a conservative and well administered department under the secretary of the interior.

But Mr. Pinchot was a young and ambitious millionaire, and having a clear and far seeing mind, perceived the great possibilities in store for a bureau of forestry under the new department of agriculture, and with himself as its head. Further, Mr. Pinchot is blessed with a very pleasing and captivating personality, which made it possible for him to convince the people that it was for their best interest to surrender their rights to a government bureau presided over by himself as absolute dictator.

Had the people of this country perceived the tremendous power, which this bureau of forestry could wield over them and the states in which they live, the plan could never have been carried to the extent desired by Mr. Pinchot. From the lands they embrace the people of the West must draw their very life blood,—water, minerals and fuels. He who can control these under a government bureau giving him absolute power has the people of the western country for his serfs. Once well intrenched with all the power to issue permits revocable at his will, to levy charges for the use of water, minerals and other resources of these mountain reserves in the amount he may decide, and to enact and enforce the many and varied regulations invented by the fertile mind of Gifford Pinchot, the head of the forestry bureau will be invested with imperialistic power. The things he would control are necessary to make of any value all else possessed by the people of the West. Against such a bureau, presided over by such a bureaucrat, the people would be compelled to protest in the words of Patrick Henry: "Give me liberty or give me death."

But Mr. Pinchot's justification of it all is that corporations must not develop and control the natural resources of the country any longer. He says the "small man" must be allowed to do it. How is the "small man" without capital going to construct hydro-electric power plants costing millions, unless a large number of "small men" combine to do it, and then you have the corporations

again? The corporations developing the resources of the West are only "small men," combined into corporations, with officers and managers chosen for their ability in large business.

That the management of public utility concerns by corporate methods is the most economical and efficient has always been shown, particularly when the business covers a wide field. The only exception to this rule are some municipal waterworks, which are the simplest of all public utilites to operate, and to which every man in the community is closely related.

The best thinkers on the subject have reached the conclusion that the prevention of unjust treatment of the public at the hands of public utilities lies in their regulation by state commissions. Under such regulation there need be no fear of monopolies, and the excuse for giving the resources employed in public service over to the Federal Government to prevent monoply falls

On the other hand, the people of the United States are well enough educated to know that the most dangerous monopoly of all is a government monopoly. When a people loses its liberties, is oppressed, taxed and downtrodden, this is always and always has been, at the hands of government monoply. Contrast the condition of the people of the Unted States, where the important affairs of business are all controlled by the states, with the condition of people in other countries, where a central government controls everything.

The real danger to any nation lies in placing too much power in the hands of a central government far from the people themselves. If the states control, the popular influence is nearer and stronger to direct the government to do right.

History teaches us that the manner in which people are usually deprived of their liberties is just the way in which the so-called "New Nationalism" proposes to do it. At the bottom of all such schemes is hero worship, that universal trait of human nature. In the present case we have two men, Roosevelt and Pinchot, both very popular with a certain class of the people. These men are both as shrewd politicians as the world has ever known, both have had the opportunity, while in the public office, to create a strong personal following, and while their star was in the ascendency, they both took advantage of this weakness of human nature. There are thousands of men who are ready to endorse anything put forward by Roosevelt or Pinchot, even when it is against their own interest. But the people are now beginning to ask "what is what," instead of "who is who," hence the change in public sentiment and the waning popularity of these two prominent Americans.

There has never been any reason advanced for the theory that the Federal Government should control, lease or otherwise convert to its use the natural resources within the different states. On the contrary, whenever anyone has given sound reasons why this should not be done, he has been met with the accusation that he cannot be trusted, because he may own or represent interests, corporate or otherwise, which are engaged in the development of natural resources, or devoting their capital and energy to public service.

Thus at the Eighteenth National Irrigation Congress held in Pueblo, Colorado, last September, Mr. Pinchot's address merely consisted in proclaiming that speakers and delegates who had any connection with corporations must not be given credence, and he followed this up by moving that any delegate hereafter addressing the Congress should state his connection with corporation business, if any, before speaking. Well does Mr. Pinchot know that every delegate of much prominence at irrigation congresses is either interested in water companies, power companies and other lines of western development, or else he is a politician of Mr. Pinchot's school and therefore desires to have all business controlled by government bureaus. Apply the gag to those who risk their capital and energy to develop the country, to make homes, prosperity and employment for millions of people, with sometimes a profit to themselves, and as often a loss, and let the political adventurer, who labors not and risks nothing, be heard in favor of creating government monopoly, which once well established, may require a revolution to again emancipate the people.

Yet, the writer, who was a delegate to the Pueblo Congress, seconded Mr. Pinchot's motion, believing that this sort of demagogy is best exposed by meeting it openly. Have the people who represent the business interests of the country no right to be heard? Why should a man be afraid to speak up because he is financially or professionally interested in corporations? Are not the funds of estates, belonging to widows and orphans, the savings of the poor and the surplus earnings of professional people, as well as the capital of the wealthy, invested in these corporations?

Long enough have the men who represent the solid business interests, which by the investment of capital in railroads, power plants, irrigation works, mines, factories and a thousand kindred industries, made the masses more prosperous and wealthy, been intimidated by demagogues, agitators and politicians. Let them henceforth stand up erect, proclaim who they are and "call" the Roosevelt-Pinchot bluff.

With an opportunity to present facts and arguments, the following matters will become clear:

1. The law has vested in the different states the waters of non-navigable streams within their respective borders to dispose of to those who, in compliance with the state laws, will develop them for beneficial purposes. The different states may give away, sell or lease these waters to the people, and profits, whether direct returns in cash or indirect benefits to the community, ought to belong to the states and not to the Federal Government.

2. In non-navigable interstate streams the different states have a right to grant, lease or otherwise dispose of the waters within their own borders, with due regard for the rights of neighboring states through which the same stream may flow. The profits of whatever nature resulting from the disposition of such waters should belong to the states and not to the Federal Government. Disputes regarding interstate streams, as between different states, must be settled by the Federal courts, with due regard to the needs, conditions and laws of the litigant states.

3. Navigable streams, no matter where located, belong to the Federal Government for its use in promoting commerce, but concessions to the states to dispose of the waters of such streams for other purposes, when not inconsistent with the requirements of commerce, or when they are more valuable for other purposes, should be made.

4. The disposition of minerals on public lands within a state should be left to the state, not only because a state is entitled to this right to develop its natural resources, but because the people of a state, being in closer touch with local conditions, can better and more safely be intrusted with its management. The soundness of this position is demonstrated by the fact that the Federal Government has usually been defrauded out of valuable resources controlled by it, while the states have usually realized a profit and disposed of their resources under proper safeguards. Examples of this are seen by the respective ways in which the iron deposits in Minnesota were disposed of by the state and the Federal Government, the manner in which the coal lands in Colorado were handled by that state and the United States, etc.

5. The natural resources of each state are needed for its own development and prosperity and the Federal Government cannot rightfully tax them for the benefit of the entire country, unless all the states would be proportionately affected by such taxation. The states will not be thus affected because they do not all possess undeveloped natural resources in the same proportion, and some states like Texas own their own resources and would take from the others without giving anything in return.

6. For Federal Government to tax by leasing, or otherwise, the resources yet to be developed in certain states, will only inure to the benefit of corporations already in possession of similar resources, which the government has no power to tax.

7. A Federal bureau for controlling the resources of the states is an infringement of the liberties of the people, and a step towards monarchal government by changing from democracy to bureaucracy.

8. Private monopolies can be controlled by state and national commissions for the regulation of the business of corporations, but a government monopoly once firmly established, can only be dislodged by revolution.

THE PRIMER OF HYDRAULICS*

By FREDERICK A. SMITH, C. E.

4. *Properties of Gases.*

a. General deductions.

Gases are bodies in which the molecules possess no cohesion whatever, and tend therefore to separate from each other. Thus it requires force to keep the particles of any gas or vapor together, such as a closed vessel, or, as in the case of the atmosphere, the force of gravity, which prevents our air from leaving the earth.

b. Density of Gases.

All gases and vapors possess weight, but there is much difference in the weight of different kinds of gases. The lightest gas known is hydrogen, and as for fluids and solids, water is taken as the unit density, so for gases and vapors hydrogen forms the base and its density is called 1; then the densities of other gases are multiples; for instance, the density of oxygen is 16, of nitrogen 14, of carbon dioxide 22, etc. The density of air is 14.44, which means that one cubic ft. of air weighs 14.44 times as heavy as hydrogen.

c. The Pressure of the Air on the Surface of the Earth.

The atmosphere surrounds the earth like a mighty ocean many miles in thickness, and the weight of this mass of air presses on the surface of the earth. That this pressure is everywhere was first proven by Torricelli in the following manner. He took a glass tube *DC* (see Fig. 70), which was closed at D, filled it with quicksilver, closing the end *C* with his thumb, and immersed the end *C* under the surface of quicksilver contained in a vessel *AB*; then withdrawing his thumb the quicksilver in the tube dropped a distance until the distance to the surface *AB* of the quicksilver amounted to 30 inches; the fact that the quicksilver did not run out of the tube is accounted by the pressure of the air on the surface *AB*. And as the 30 inches of mercury just balance that pressure it shows that the pressure of the air on the earth is equal to that of a quicksilver ocean 30 inches thick, and as quicksilver is 13½ times heavier than water it is seen that if instead of quicksilver water would be substituted in the tube *DC*, then the pressure of the air on the surface *AB* would balance a column of water in *CD* equal to 13½ times 30 inches, or nearly 34 ft. This principle accounts for the air pressure lifting water in pumps and shows also the limits of such lift, the maximum of which at sea level would hardly reach 30 ft.

The air pressure diminishes rapidly in higher elevations because the thickness of the atmosphere decreases as well as the density, the density at sea level being ordinarily a maximum. On high mountains the density of the air and the air pressure is perceptibly less and pumps will therefore not lift water as high as in lower altitudes.

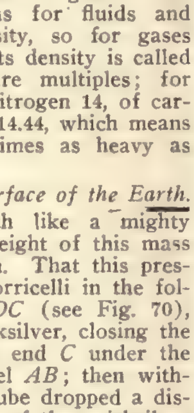


Fig. 70.

d. Compressibility of Gases.

If a bent glass tube *EC*, as in Fig. 71, with the short arm *C* closed, is filled up to the line *AB* with quicksilver, then there is a certain amount of air imprisoned in the short arm of the tube. If now quicksilver is added in *E* carefully, it rises in both arms, and when it reaches a point *D*, 30 inches above *C*, it is found that the original volume of the air in *BC* has been reduced ½, and likewise the pressure on the air has been doubled, as in addition to the original air pressure the weight of 30 inches of quicksilver has been added; if more quicksilver is poured into *E* until the top of it at *E* is 60 inches above the top of the quicksilver at *G*, then it will be found that the volume of the air in *G* is ⅓ of the original, and the pressure on that air is three times the air pressure. This experiment explains the important law of Boyle, which states that the volumes of gases are inversely proportional to the pressures; thus a cubic ft. of air under a pressure of 10 atmospheres (150 lbs. per square inch) will occupy only the space of 1/10 of a cubic ft. Insersely, when the pressure is relieved the gas expands without limit.

e. Buoyancy.

Bodies immersed in gases lose as much weight as the volume of the gas weighs which they displace. In this regard gases are similar to fluids, and the principle is vital in the navigation of the air. Balloons filled with a gas lighter than air will rise in the air when the weight of the displaced air is greater than the combined weight of balloon and gas with which it is filled. As hydrogen is the lightest substance, it forms the most desirable gas for filling balloons as it has a greater buoyancy than any other gas.

f. Evaporation in Air.

When the surface of air is in direct contact with fluids evaporation takes place, i. e., portions of the fluid assume the gaseous state and this continues until either all the liquid is evaporated or the air has become saturated. Thus the air can only hold a certain amount of the vapor of any particular fluid; this capacity is, however, increased by an increase in temperature.

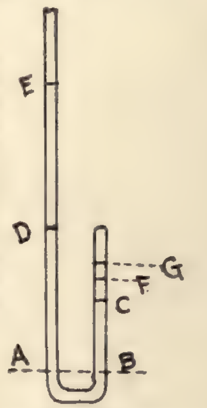


Fig. 71.

*Copyrighted by D. R. Anderson.

LIGHT IN RELATION TO TREE GROWTH.

The Secretary of Agriculture has just issued Bulletin 92 of the Forest Service on "Light in Relation to Tree Growth." The bulletin is designed to show the benefits derived by the tree by light from all angles, particularly that reflected on the roots.

In introducing the subject the bulletin states: "Light is indispensable for the life and growth of trees. In common with other green plants a tree, in order to live, must produce organic substance for the building of new tissues. Certain low forms of vegetable life, such as bacteria and fungi, do not require light. They exist by absorbing organic substance from other living bodies; but the higher forms of plants manufacture their own organic material by extracting carbon from the air. The leaves, through the agency of their chlorophyll, or green coloring matter, absorb from the air carbon dioxide, and give off a nearly equal volume of oxygen. The carbon dioxide is then broken up into its elements and converted into organic substances which are used in building up new tissues.

"Light also influences transpiration, and consequently the metabolism of green plants. It influences largely the structure, the form and the color of the leaf, and the form of the stem and the crown of the tree. In the forest it largely determines the height growth of trees, the rate at which stands thin out with age, the progress of natural pruning, the character of the living ground cover, the vigor of young tree growth, the existence of several-storied forest, and many other phenomena upon which the management of forests depends. A thorough understanding, therefore, of the effect of light upon the life of individual trees, and especially on trees in the forest, and a knowledge of the methods by which the extent of this effect can be determined, are essential for successful cultural operations in the forest."

AN EXTENSION OF TIME GRANTED.

A considerable number of water users on the Minidoka irrigation project, Idaho, have found it impracticable to make payments as required by their contracts, as this has been the most difficult or critical season encountered on this project. The farms are still new and have not been fully subdued and planted in crops.

The Secretary of the Interior has therefore considered it wise to give a little further extension to delinquent entrymen who have tried to make payment and has made the proposition that if the directors of the Water Users' Association will verify the fact that certain of the water users have tried to comply in good faith with the requirements of the Reclamation Act, and that they will pay all charges for building, operation and maintenance, which should have been paid on or before April 27, the secretary will defer cancellation until Dec. 31, 1911.

This requires the Water Users' Association to assume

responsibility as well as the individual concerned, and not only strengthens the organization, but gives the secretary assurance that the men for whom special favors are asked are worthy of consideration and thus obviates any impossible injustice to deserving individuals.

SOME PRINCIPLES OF WEED CONTROL.

Weeds may be roughly divided into two classes: those which grow and spread entirely from seed, and those which, in addition to this, propagate by means of perennial roots or underground stems. The first class is made up largely of annuals, plants which start from seed, produce flowers and ripen seeds the same season, after which the whole parent plant dies. The pigweeds, tumbleweeds, marsh elder, wild sunflower, and mustard are examples of such weeds. They are best controlled by rooting them up when young, as in hoeing, cultivating, pulling by hand and, in some cases, by chemical sprays. To prevent their going to seed is the principal thing.

In the second class are found the poverty weed, iron weed, Canada thistle, and field morning glory. Such plants, when once established, are very persistent and constitute our worst weed pests. When cut off or pulled up, new sprouts soon appear from the underground parts, while cultivation in the ordinary way often serves to scatter pieces of the plant to other parts of the field where they may take root. The only remedy consists in digging out and removing every part of the plant, in choking it out by means of some stronger growing crop plant, such as alfalfa, or by starving the underground parts of the plant. The last method is accomplished most frequently by careful and constant hand hoeing and pulling, on small areas, supplemented by thorough cultivation on large areas. To be effective this method requires that every sprout which comes above the surface be cut off, or pulled, or otherwise destroyed.

The food of such plants is manufactured in the leaves that come to the light, hence if every sprout is cut off before the leaves have time to get to work, it is merely a question of one or two seasons until the underground parts are no longer able to put up new sprouts.

Anything that kills the foliage will also accomplish the same thing. Unfortunately most of these plants are not greatly injured by chemicals other than those that are poisonous also to animal life.

Turning the infested area into a sheep or hog pasture for two or three years, especially if the animals are somewhat crowded, has been found effective in some cases, such as land infested with the field morning glory.

In any case persistent, thorough work is necessary to success in eradicating weed pests of this character, and the best time to begin is just as soon as the weed is discovered and before it covers large areas.

B. O. LONGYEAR,
Colorado Agricultural College, Fort Collins.

THE PITTSBURGH LAND SHOW TO BE AN ANNUAL AFFAIR HEREAFTER.

The phenomenal success of Pittsburgh's big land show last year has encouraged the management to make it an annual affair. The show ran for twelve days and nights last year and had an enormous attendance of over 180,000 people. This year the time has been extended to fifteen days.

The exhibitors at the show last year found that the people in the Pittsburgh district were eager for the information to be distributed by the exhibitors. On account of no state or county fair in the Pittsburgh district, the land show had an enormous attendance of farmers, and all of the exhibitors were more than pleased with the results. Many of the same exhibitors will be found in the show this year.

Duquesne Garden is a building well adapted for land shows and is in a location easily reached by the many big trunk lines of the street railway system.

There is a big contest on between the farmers of the three states, Pennsylvania, Ohio and West Virginia, and the management of the land show is offering fifty beautiful silver cups and trophies for the best products of the three states.

The show will be advertised in all the local newspapers and on billboards and various lines of novelty advertising. Special lithographs of various sizes are used and bill posters cover all the country territory, as well as city. The people in the Pittsburgh territory are looking forward with great interest for this big event.

STATISTICAL RECORD OF THE DEVELOPMENT OF THE UNITED STATES.

Seven hundred and fifty pages of solid figures unaccompanied by text discussions other than explanatory notes, form a rather uninteresting looking volume issued by the Bureau of Statistics of the Department of Commerce and Labor, entitled "Statistical Abstract of the United States," yet this annual volume, the thirty-third issue of which has just made its appearance, is called for by thousands of people in every part of the United States, and in fact in every part of the world. It tells of the area, natural resources, and population of the country from the adoption of the constitution to the present time; agriculture, forestry, and fisheries; manufacturing and mining industries; occupations, labor, and wages; internal communication and transportation, merchant marine and shipping; foreign commerce, internal commerce, commerce of noncontiguous territories; prices, consumption estimates, money, banking, and insurance; wealth and public finance; the civil service, army, navy, pensions, congressional apportionment, the presidential elections; the statistical records of progress of the United States from 1800 to 1910; and closes with a few pages devoted to commercial, financial and monetary statistics of the principal countries of the world. It is compiled by the Bureau of Statistics, in part from its own data of commerce and transportation, in part from data gathered by other governmental organizations.

VISITORS FROM NEW SOUTH WALES.

Neil Neilson, minister of lands in the New South Wales cabinet, will come to the Pacific slope country early in September to make a thorough investigation of the various systems practised in the irrigation states, according to advices received by the Spokane Chamber of Commerce from Sidney.

Mr. Neilson plans to visit many districts in Washington, Oregon, California, Idaho, Montana, North Dakota, Wyoming, South Dakota, Texas, Arizona, Nevada, Utah, Oklahoma, Colorado and New Mexico, also the government plants in Nebraska and Kansas, going thence to Chicago and New York. He will confer with the Australian authorities in London and visit the principal cities on the continent.

Percy Hunter, vice-president of the Hands-Around-the Pacific club, who is slated for under secretary of New South Wales, has come to the Northwest on a similar mission as director of the New South Wales Immigration and Tourist Bureau, to which position he was appointed by Sir Joseph Carruthers, prime minister of New South Wales. He also contemplates visiting various parts of the United States to familiarize himself with irrigation methods.

Mr. Hunter was interested in the Inland Empire by Victor M. Smith, auditor of the Spokane Chamber of Commerce, while making a tour of the Pacific island. Mr. Smith, who will accompany the Australian through several states, says in a letter to R. J. Maclean, secretary of the local commercial organization:

"Australia plans to do everything possible to promote a better feeling between the two countries and to improve our trade relations. The trip undertaken by Mr. Hunter, who, by the way, was formerly a newspaper writer at Sidney, is important in many ways."

The Missouri Texas Land & Irrigation Company, of Houston, Texas, capitalized at $1,000,000 recently filed its charter with the Secretary of State. The corporation is to operate in the Brownsville country. The incorporators are H. P. Hilliard, of St. Louis; Henry L. Borden, of Houston, and R. L. Betts, of Austin.

CORRESPONDENCE

WANTS INFORMATION REGARDING PACKING ATTACHMENT.

Mr. D. H. Anderson.

Dear Sir:—I have put in this year 75 acres of valley land under irrigation. I had the land grubbed, cleared and fenced last year, plowed part in the fall and the balance this spring. I am located on the N. Llano River in Kimble County. I bought and had erected thereon a 25 horse-power gasoline engine and 6-inch Centrifugal Pump and commenced irrigating this spring. The land is a gray, sandy loam, very porous and absorbs a great deal of water, and I am told will for one or more years. In reading over your Primer of Irrigation, I notice what you say as to the packing of the bottom of the furrow on page 109, and I believe that if I can do it that I will thereby economize a great deal of water and also benefit my crops. I have written to two large implement firms as to a packer attachment, but they don't seem to know of any such plow attachment, so I take the liberty of writing to you for a favor, which is to please furnish me with the name of a firm from whom I can purchase said attachment for my plows, and if said firm is located in Chicago please request them to furnish me with description and price of same, thereby saving time; also furnish me with name of firm, also name of attachment, if any besides packer attachment. Thanking you in advance, I remain, Yours truly,

C. L. DUNBAR,
Junction, Kimble Co., Texas.

Can any of our readers give the desired information to Mr. Dunbar? It will be appreciated and may be sent to THE IRRIGATION AGE for publication.—Editor.

MORE LIGHT ON THE FINANCIAL QUESTION.

To the Editor:

The very first effective move against the real cause of the country's most serious trouble was made on the eighth of July by Representative Lindbergh, of Minnesota, when he introduced a resolution proposing an investigation by a house committee of nine members to determine if there exists a combination of financial interests in the United States operating in restraint of trade. The scope of the resolution includes an examination of the banking, money, exchange, credit and deposit systems of the country, and recommendations for remedial legislation. In proposing this action, Mr. Lindbergh declared that "Wall street brought on the panic of 1907, and if it dares will produce another panic to pass the Aldrich central bank plan." "We need reform," he added, "but not at the hands of Wall street." It is Wall street that needs reforming.

July 26th, Mr. Lindbergh went before the house rules committee, to which his resolution had been referred, and after hearing him, the committee decided to report it favorably, and to ask that the investigation be made either by the monetary commission or the house committee on banking and currency, probably the latter. This brings the matter up to a point where the government will have to take some kind of action, and with Mr. Lindbergh to press it, backed as he will be by the entire west, the investigation will have to be thorough.

The west having suffered far more severely than any other part of the country from the merciless operations of the banking trust, it becomes at once the urgent duty of every western man to furnish Mr. Lindbergh all possible assistance, not only in the form of moral support and public agitation, but by evidences of the acts of this pernicious trust and its agents, and the effects of those acts, direct or indirect, upon the prosperity of the country and the rights, freedom and material interests of individuals. These acts and their consequences are well enough known to practically every western man of affairs and every such man has suffered by them. It is an undisputed fact that all who have been interested in the most important activity of these times, the extension of cultivable land areas by reclamation or other means, have felt the heavy hand of Wall street in checking and preventing all such improvements and all movements whereby our people have wanted to acquire new lands or go into newly opened regions of greater fertility than the old. All evidences that will help place that fact before congress and the nation should be given to Mr. Lindbergh.

The efforts of banks to prevent depositors from withdrawing money for the purpose of making land purchases are acts of this kind, and should be reported. So should all letters from bankers in any part of the country, discouraging land purchases or the investment of private funds in irrigation projects. Whoever has knowledge of the acts of bank examiners in throwing out securities based on land values should tell what he knows in order that the bankers and examiners themselves may be brought before the commission and compelled under oath to tell by whose orders these high handed acts were perpetrated, in order to bring the hidden assassins to light and have their power destroyed. The whole iniquitous scheme has been carried on so boldly and openly that most of it is known to many men in the places most affected. These men should come forward.

In two preceding articles published by the IRRIGATION AGE and widely copied throughout the west, I have pointed out the evils against which Mr. Lindbergh's aim is directed and have called attention to specific wrongs, and suggested a remedy. In one of these letters I protested against the proposed Aldrich plan. Mr. Lindbergh bears out what I then said. He says:

"Under the Aldrich plan the reserve association will take away from communities funds that belong to the communities and which should be used to build up their own industries. Of the forty-five directors proposed for the association, twelve are to be elected on the basis of (bank) stock representation, and of course would be elected by the Wall street crowd, for the capital of this country is now controlled to the extent of eighty per cent by three thousand persons and concerns."

Back of these three thousand are a half dozen bloated spiders of finance, sitting in the middle of the web at Wall and Broad streets, and from that little area directing all the others in the diversion of the people's money to their meshes. It is not conceivable that this state of things can continue. The west, at least, will not endure it. The Aldrich plan must be forestalled, the financial spiderweb swept away, and the big spiders smashed.

After the investigation there must be the remedial legislation indicated in the resolution. What that legislation may be must depend largely upon the pressure of public sentiment, operating through congress. If Mr. Lindbergh succeeds in engineering the investigation through successfully and a system of real banking can be set up in the place of the monstrous abuse that now goes by that name, Mr. Lindbergh, himself, will have earned the right to be called another Lincoln, for he will have freed his country from a new slavery, where the actual producers and earners are nothing more than the chattels of Wall street, through the operation of the greatest and most vicious trust the world has ever known.

—J. C. O'Neill.

WANTS INFORMATION ON IRRIGATION.

Mr. D. H. Anderson,

Editor IRRIGATION AGE:—

I have been a reader of your paper, THE IRRIGATION AGE, for several years; have your book, "The Primer of Irrigation," and have given a great deal of thought to the subject of irrigation. While I have always lived in regions of so-called abundant rainfall, yet I have always believed that with plenty of water at the proper time the production of crops could be more than doubled even in the so-called "rain belt," but until the present time I have never had opportunity to try out my ideas, because I had no land of my own to work on.

Now I have a little farm of about ninety acres inside the limits of the village of St. Paul Park, Minnesota, just

eleven miles from the Union Station of the city of St. Paul.

I am coming to you for help, because I know of no better authority, and I want to be sure of each step before I take it. Therefore I will give the details of my plans as they now stand; also, state the conditions of surface soil, subsoil, etc.

First, the land lays about 200 rods north and south, about 60 rods east and west, and has a slope of say 8 to 10 feet from east to west the entire length; at the southwest there is an L to the west which is about 40 feet below the main tract, the L being on the first bottom of the Mississippi river and the main tract the first bench.

The top soil will average two to three feet in depth and is a black sand loam (pronounced by one of the university experts "the best." First subsoil a reddish yellow clay with small gravel through it; this is three to five feet deep; below that is a rather coarse sand—I do not know how deep.

Now, since most of the land is second bottom, or bench land, and since the surface has a fine slope to the west, you can see that I have a perfect outlet for either irrigation or drainage, and a perfect condition for distributing water or draining it off.

Of course, they have considerable rainfall at that point, but it is uncertain, yet it is useless to consult the fellows at the state university, for they just laugh at me for thinking of irrigating, but I know what I am about and I am going to do it, and it is to learn the best method of doing it that I come to you.

I know there are a number of methods which might be practical, but the one which I now have is this:

Since it is not likely that I can get surface rights to any water at that point, I plan to sink wells (there being an abundant supply of underground water at about 75 to 100 feet), put in as many pumping plants as needed and lay cement tile all over the tract. It seems that the cement tiles are so much more porous than the clay that it seems to me they would be the very thing. Now I would lay the tile at a uniform grade with a main supply pipe at the head and a main outlet pipe at the lower end. I would construct the ditches so I could stop the flowage at certain points; also to stop the entire flowage at the main outlet. In this way a given section of the land could be watered or drained as desired. I would arrange so that the water could be raised to the surface at any point for surface irrigation; then I would arrange to open all the lines and permit the air to circulate, thus securing the four important items of sub-irrigation, surface irrigation, drainage and soil aeration with the same system, to which might be added the advantage of complete surface cultivation.

Now, will this plan be practical? Will cement tile be durable? How deep should they be placed in that soil and climate? What sized tile should be used? If you can suggest any other better system I shall be glad for the suggestion. I want all the information I can get on the subject of pumping plants, water needed, etc., etc., and will gladly pay for all I can get if you will give it to me or tell me where I can get it.

Would it be wise to put in the tile this fall or in the spring? I will say it is my purpose to make a truck farm of the land in question. An early reply will be greatly appreciated.

I recognize the fact that I am taking great liberties in addressing you at such length, but I know of no other way to get what I want and take my chances on receiving attention. Yours very truly,

R. W. Weller.

Mr. Weller's inquiry covers a great deal of ground, and while the editor agrees with him in most of the plans and statements, he feels that he should counsel Mr. Weller to make haste slowly. The improvements planned will cost considerable money and instead of trying to make a complete and finished job of the proposition at once, we advise Mr. Weller to either consult an hydraulic or irrigation engineer on the subject, for though the description given makes the plan fully feasible, yet a survey should be made of the land before planning such extensive improvements. Otherwise we would advise to first sink the well and install a pump. Figure on the volume of water probably required, taking into account that much of the moisture needed is supplied by rain. The cement tile will no doubt be injured in the winter by the frost unless laid below the frost line, hence it would be best to try open ditches first, and thus the other improvements may then gradually be made.—Editor.

WANTS PLAN FOR POWER PLANT.

Delta, Colo., July 22, 1911.

Irrigation Age,
30 N. Dearborn St.

In reading your article on electricity on farm, I see you considered an under-shot wheel for most power under a small head. Would you please publish in your next issue a plan for a small home-made under-shot wheel for a 6–foot fall with 47 cu. ft. of water per minute at low water and three times that amount at times.

Yours truly,

M. P. Weeks.

A 6–foot fall and 47 cubic feet of water per minute can be reduced to the theoretical horse–power as follows: Multiply 47 by 62.4, which gives 29,328 pounds of water per minute; multiply this by 6, gives 175,968 ft. pounds; divide this by 33,000, gives 5.33 theoretical horse-power; multiply by .6, gives 3.12 horse-power, which could be developed. This is enough power to have developed on a scientific scale and it would pay Mr. Weeks to have this power project examined by a mechanical-hydraulic engineer. It would be a shame to spoil a good thing by improper development.—Editor.

IRRIGATION PROBLEM IN COLORADO.

Mr. D. H. Anderson,
Publisher The Irrigation Age:

Dear Sir: Being a suscriber to The Irrigation Age, will you kindly give me the information desired? I have a well 53 feet to the water and intend digging it 13 feet more, making a depth of 70 feet, and having well reservoir of 13 feet deep by 6 feet cross. According to my estimate this well reservoir 6 feet in diameter and 13 feet deep will hold about 3,232 gallons, which I can fill from three to five times a day. Will you kindly inform me which is the better to use, a windmill or a gasoline engine for pumping the water on the 10 acres, and would you advise a small reservoir. To irrigate 10 acres one inch would require about 271,000 gallons, I think, considering the loss by evaporation. Would it be more advisable to pump the water into a small reservoir or directly on the land, which I could do mostly at night when evaporation would not be so great? Have you a publication on the cost of small reservoirs and irrigation propositions? Thanking you for this information, I am,

Respectfully yours,

M. T. Keister.

P. S.—I could sink the well to a greater depth, say 80 or 90 feet, or raise it to a reservoir above well, whichever would be most practical. M. T. K.

The circular tank 6 ft. diameter and 13 ft. deep holds 2,760 gallons, which, if filled five times per day means 13,800 gallons. Ten acres of land contains 435,600 square feet and if covered with water one inch deep would require 435,600x144 cubic inches, equal to 49,526,400 cubic inches, which, when divided by 231, reduces the amount to gallons, making 214,356 gallons. This would require about 15 days, as outlined in Mr. Keister's letter.

If the supply of water is sufficient it would be better to put in a gasoline engine and a pump large enough to pump directly into the ditches, in which case the loss of evaporation is much smaller than pumping into a reservoir.

However, a good reservoir with a capacity of about 200,000 gallons would be desirable, as then the pumping could be done by windmills and the cost of the gasoline would be saved.

It will be best to engage an engineer for the planning and building of reservoirs, as it is very particular work, which can hardly be done satisfactorily and safely by untrained hands.—Editor.

Reclamation Notes

CALIFORNIA.

The four great pumps of the Sacramento Valley Irrigation Company at the head of their canal near Hamilton City were simultaneously put into operation and tested recently. They lifted out of the Sacramento river and poured into the great canal the enormous volume of 900 cubic feet of water a second.

An option on the old Woodbridge canal, near Modesto, and water rights has been secured by property owners of that section for $350,000. The formation of a Wright law irrigation district is contemplated. Woodbridge district comprises 70,000 acres, many of which are already under irrigation.

Mass meetings are being held by the farmers of the West Side county, including Mendota, Firebaugh, Dos Palos, Newman, Crows Landing and Los Banos, in the interests of forming an irrigation district under the state law.

At a joint meeting of the directors of the Oakdale and South San Joaquin irrigation districts, all bids were rejected for that portion of the bonds of the two districts whose proceeds were to be applied to the construction of the dam and other works to be built at joint expense. As a contract had probably been virtually agreed upon before the bonds were advertised, the rejection was apparently made in the expectation of better terms. The bids for other bonds of the South San Joaquin district were also rejected.

Work on the third big syphon has begun by the Sacramento Valley Irrigation Company. This work is only preliminary. The syphon crosses Willow Creek, and is an immense affair. Two syphons were put in last summer at the Walker Creek crossing, but they were small ones as compared with the one now begun.

The rapid sale of lands in Subtract No. 2 of the Patterson Irrigated Farms, Patterson, has made it necessary to hasten the work of laying out the sub-laterals. About 5,000 acres of this land are now in grain with an average yield of about twenty-five sacks to the acre.

COLORADO.

Dr. R. D. Elmore, of Broomfield, was recently in Fort Lupton organizing the farmers under the Standley lake irrigation project into a body for offense and defense. It is understood similar organizations will be formed in all parts of the district. No irregularities are charged, but close watch is to be kept.

Windsor Lake, adjoining Windsor, is being surveyed for the first time. Although one of the oldest lakes used for irrigation, its capacity is unknown. It is understood that the survey is made because of future litigation to come up by water users down the river, who claim that water is being turned into the lake to which they are entitled. It is estimated that the lake has a capacity of 60,000 cubic feet of water.

It is announced that work will start on a $250,000 irrigation project in the Big Park country for the purpose of irrigating from 10,000 to 20,000 acres of land in the Big Park. The prospect is backed by two promoters, Messrs. Armstrong and Shaw of Butler, Pa., who have been at work on the proposition for some time. Water will be taken from the Little Dolores and East Creek and will irrigate all of the land settled in the Big Park.

An irrigation project in the vicinity of Pueblo was voted upon recently and the vote of the property owners was unanimous for the organization of the district. The proposition is to irrigate 50,000 acres of land and the estimated cost is $2,500,000. Old water rights on the western slope have been secured and the water is to be taken down the Arkansas river and stored in reservoirs.

A series of reservoirs and ditches to cost $29,000 is to be built by Denver people to reclaim by irrigation and develop the country in the vicinity of Sligo.

The Pueblo Land & Irrigation Company, through C. E. Sutton, president of the company, have filed maps of the Park Lake reservoir and Thompson reservoir with the county clerk. The reservoirs will irrigate 3,400 acres of land and will cost $17,000 to construct. The land is in the Orchard Park district.

Two more suits against the Pueblo-Rocky Ford Irrigation Company were filed recently in the district court of Pueblo county by dissatisfied land buyers who signed contracts for the purchase of lands under the project. The suits involve the recovery of about $4,000.

Several farmers in the arid regions east of Denver believe that by sinking wells the underflow of streams can be utilized with pumps for irrigation.

Actual construction work on the Havemeyer ditch between Rifle and De Beque will be started in a short time by contractor J. J. Lumsden. Engineer Warning stated recently that the preliminary work of starting a camp has already been started. The length of time that will be needed to finish the canal is indefinite.

The Terrace Irrigation district, comprising about 400,000 acres of land, situated between LaJara and Monte Vista, has arranged to purchase the Terrace reservoir and also the La Jara Meadows reservoir. The La Jara Meadows reservoir is now completed and filled with water and has a capacity of about 16,000 acre feet of water.

Probably the most expensive irrigation pipe line and pumping plant system ever established in northern Colorado is being installed by W. S. Freeman, a Chicago attorney, on his ranch near Briggedale, at a cost of $47,500. The water is to be drawn from underflow streams and seepage from Crow creek, and 4,000 acres will be irrigated.

The Poudre and Platte rivers are rising and ditches are running full with surplus water going into reservoirs. The prospect of a good supply for late irrigation is the best in years, and this means the making of the beet and potato crops.

MONTANA.

Professor Bonebrigh of the Experimental Station, Bozeman, is conducting a valuable series of experiments to determine the amount of irrigation that can be profitably used for different crops and also the relative amount required by different soils. The result of his experiment will be published in bulletin form later and will contain valuable information for farmers on irrigated lands.

A scheme for the reclamation of 20,000 acres of land lying along the Little Missouri river in Custer county, 75 miles south of Baker, is being projected by Butte men. It is understood that the backers of the project are expecting a railroad to tap the district when the lands will be placed on the market.

There is a small force of men making ready to begin work on the Sun river irrigation project. Houses are being erected to shield the men and general exploration is in progress.

Affairs of the Valier irrigation project have been adjusted. Work is to recommence at once and the project is to be completed by June, 1912. This was the news brought to Great Falls by James T. Stanford of the Conrad-Stanford interests, who has been in the east, and

who for the past 18 months has been engaged in arranging for the continuation of work on the Valier project.

NEW MEXICO.

Water has been turned back into the big canals of the Carlsbad project and the farmers are again busy night and day. Night irrigation has become general in the project, for experience has proven that it pays well. The reservoirs are full and everyone can have water promptly.

The largest irrigated land deal of the present year has been consummated at Deming. The Rio Mimbres Water Users' Association has sold out a large part of its holdings lying east and southeast of Deming, consisting of 4,000 acres of irrigable lands. The men who have acquired this land are amply able and intend to develop it by means of pumping plants operated by electric motors.

T. M. Boatwright of Alamogordo, N. M., has made his first cutting of alfalfa, grown nearly entirely with winter irrigation. He cut 22½ tons from a little over eight acres, selling from $12.50 to $14.00 per ton. Mr. Boatwright soaked his alfalfa land thoroughly during the winter months and his first cutting was ready before any other alfalfa in that section. So much for winter irrigation, when there is plenty of water and the evaporation is not so great as in the summer.

OREGON.

The Ana river irrigation project at the head of Summer Lake Valley, will soon have water on the lands of the settlers under the ditch. This project will make thousands of acres of land into alfalfa, grain and fruit ranches. The water is raised by a large pump from the famous Ana river springs, five in number, that pour forth a large volume of water some thirty-five feet below the surface of the valley.

The Weed canal, the big ditch that has its entrance and outlet in the head waters of the Upper Klamath lake, and which will reclaim thousands of acres of land, is now open from source to mouth. In addition to furnishing water for irrigation this canal will bring lake steamer navigation within three miles of Fort Klamath.

UTAH.

The Secretary of the Interior has awarded contract to W. O. Morrison, of Denver, Colo., for the construction of the Indian Creek dike on the Strawberry valley project in Utah. Four bids were received, the lowest and successful bid being that of the Denver contractor for $107,990.70.

One of the largest irrigation and power projects ever undertaken in the state of Utah is soon to be launched in Uintah county. The proposed project will bring under cultivation about 400,000 acres of the most fertile land in the Uintah district, and incidentally provide for the operation of an immense power plant. The greater part of the land to be irrigated is on the east side of the Green river.

The Utah Lake Irrigation Company has just completed the final survey for its pumping plant and canal west of Jordan river. The canal will be 99 feet above the level of the lake and will be about thirty miles long. Ten thousand acres of wild desert land, most of it now growing nothing but sagebrush, will come under the system.

WASHINGTON.

The Wenatchee Valley Orchard Company has recently purchased a pumping plant for their Sunnyslope property, which will irrigate orchards 830 feet above the river level. The cost of the pumping plant and machinery is something more than $20,000, it is said.

Senator Jones and L. M. Rice of Seattle, who have been in consultation with Secretary Fisher for some time,

urging approval of the application of the Klickitat Irrigation and Power Company for right-of-way across the Yakima reservation for an irrigation canal, finally succeeded in having a satisfactory plan arranged by which the work can go forward. This enterprise contemplates the irrigation of 30,000 acres of land in Benton and Klickitat counties, and when completed will be one of the largest projects in the United States.

A deed for 716.88 acres of land, to be made into an irrigation project, has been filed with the county auditor by the Washington Irrigation & Development Company. The land lies in one tract, beginning in the southeast corner of Kittitas county and extending into Yakima and Grant counties. The price paid was $60,000.

MISCELLANEOUS.

The Government Irrigation Ditch on the Shoshone Indian Reservation, Wyoming, has been completed across Boulder flat to the North Fork boundary on the reservation, a distance from the agency of 14 miles. The construction of the immense irrigation system on the reserve has so far cost the government more than $600,000 and is not yet completed.

Preliminary work on the survey for the proposed irrigation work east of Rapid City, S. D., has been finished by a crew working on Box Elder divide for the Rapid Valley Irrigation & Reservoir Company. A spot 25 miles east of the city has been selected as the site for the reservoir.

The big Portneuf-Marsh Valley Irrigation project of southern Idaho, has just been taken over by Kidder, Peabody & Co., of Boston. The Portneuf company has a capitalization of $500,000 and an outstanding bond issue of $300,000.

The state engineer of South Dakota recently issued a permit to George H. Lang of Rapid City to appropriate 4.3 cubic feet of water from Box Elder creek for irrigation purposes. The project comprises the irrigation of nearly 3,000 acres of land.

An irrigation enterprise, entailing the expenditure of from $50,000 to $75,000 and embracing upwards of 3,000 acres of the semi-arid pastures surrounding Whitewood, S. D., has been floated by local men under the direction of State Engineer Samuel Lea. The plan contemplates the erection of a conversion dam near that city, the laying of conduits and a storage reservoir and a clarifier with a patent process.

It is reported that Joy Morton and the Roberts company have come to terms over the Wyoming Central Irrigation project and that the Roberts interests will acquire Morton's holdings.

The Medina dam and irrigation project, which is being financed by English capitalists, is evidence of the confidence that foreign capitalists have in the future possibilities of Texas. The dam which is being constructed is over 1,300 feet long.

For three dollars paid now you will secure The Irrigation Age for one year and a cloth-bound copy of the Primer of Hydraulics, the only work on Hydraulics written for plain people.

A NEW LINE TO THE GOLDEN GATE.

Announcement is made by the Denver & Rio Grande of a greatly improved and expedited train service between Denver and Salt Lake City and San Francisco, to be inaugurated June 18th. On that date a new fast train (making four trains daily in each direction) will be added to the present service, and the running time will be reduced two hours. On the same date the Western Pacific will improve its service by the addition of a second daily train over its line between Salt Lake City and San Francisco.

"See the Rockies first; climb American rather than European mountains," is the text of a beautifully illustrated and exceptionally well written descriptive narrative, "The Peaks of the Rockies," by Edwin L. Sabin, the well known writer, just published by the Denver & Rio Grande Railroad Company.

Few Americans realize that right here at home, and within easy reach, the "outer" and "climber" can mount peaks in the Rockies higher and grander and scenically more magnificent than those of the Alps, and this book is issued for the purpose of disseminating information on the subject.

Appended to the story is printed a list of mountain ranges and peaks, with the altitudes of the latter and the nearest railroad stations

The Tacoma Upland Irrigation Company, of Tacoma, Wash., has filed articles of incorporation with the county auditor. Capital stock is $250,000.

The Biggs Irrigation Company, of Topeka, Kansas, capitalized at $5,000, was granted a permit to do business in Texas. Its Texas agent is to be W. W. Hubbard of Pecos.

The Rock Point Canal and Irrigation Company of Vernal, Uintah county, Utah, recently filed articles of incorporation to engage in a general irrigation project. Capital stock $2,400, divided into shares of $10.00 each.

NEWS.

F. H. Buhl, a multi-millionaire of Sharon, Pa., has another scheme for redeeming a large tract of land in southern Idaho. This man, who has irrigated more land than Uncle Sam ever did, will bring in 600,000 acres of sagebrush land at a cost of $25,000,000. This enterprise is the largest ever contemplated on the face of the globe and will be known as the Brunneau project.

The first step taken by Francisco I. Madero toward the economical betterment of Mexico was the sending out of a long telegram to all of the governors of the states, asking them to co-operate in a plan of national irrigation. The suggestion was made that all prisoners held in jails throughout the country should be organized into working companies for the construction of dams and canals so that a repetition of the crop shortages of the last few years may be avoided.

The last three years of exceedingly dry weather has caused many of the farmers of Lampasas, Texas, to install irrigating plants on their farms. There are at least eight plants within six miles of Lampasas and the acreage now under irrigation exceeds that of any previous year.

The third irrigating well, still further adding to the fame of Garden City, Kan., as a pumping center, has been brought in. It is that of Doty and Reeve, and is now flowing 4,100 gallons per minute.

A DAM THAT SEEMS IN DEMAND.

The Ambursen Hydraulic Construction Co. reports contract with the Auglaize Construction Co. for the construction of Development No. 1 on the Auglaize River, near Defiance, Ohio. The dam is 28 feet high and the total length of the concrete structure, including the power house, is 555 feet.

The Ambursen type of dam has been adopted by the War Department of the U. S. government for the dam which they are about to build across the Mississippi River between Minneapolis and St. Paul. As the dam will be built directly by the government on force account, the contract with the Amburson company takes the form of an adequate royalty.

The Ambursen Co. is also building two dams for the Department of Irrigation in Porto Rico. One on the Jacaguas River near Guayabal is 115 feet high and 1,200 feet long, and the other on the Coamo River is 62 feet high and 600 feet long. These two, in connection with the 125-foot dam for the Porto Rico Railways Co., near San Juan, makes three heavy pieces of work now under construction in Porto Rico by the Ambursen Company. The plans for still a fourth dam are now in preparation.

A COLLEGE AND ACADEMY FOR YOUNG WOMEN AND GIRLS.

The Place to Educate Your Daughters.

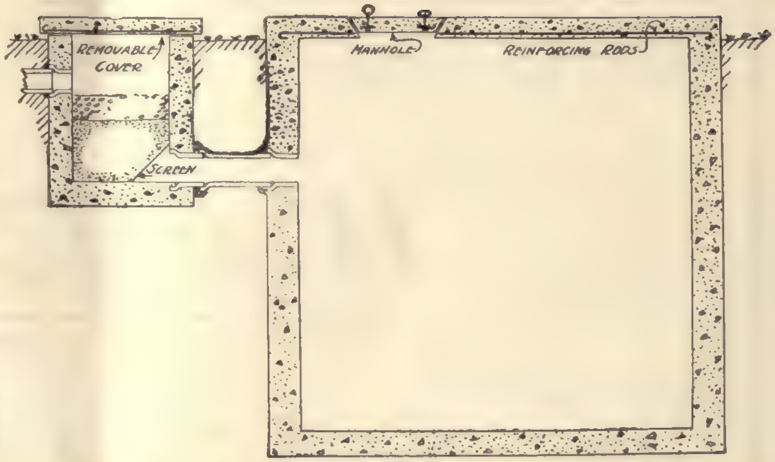
The attention of our readers is again called to the advertisement which appears in this issue, of St. Mary-of-the-Woods College and Academy for young women and girls. This institution, which was founded over seventy years ago by the Sisters of Providence, among the hills and woods of southern Indiana, has been developed into one of the most beautiful places of its kind in the country.

Its reputation an an educational institution for young women and girls is world wide, and numbers among its graduates some of the brightest women of this country.

UNDERGROUND CISTERNS OF CONCRETE.

From the viewpoint of the intelligent housekeeper, there are few things more important than an abundant supply of soft water. In the kitchen, laundry and bathroom it means lightening of labor and economy. The ideal soft water is rain water, and the old-time rain barrel, so long an institution in this country, is still extant in some rural districts. It is the purpose here to discuss the ideal "rain barrel," a reservoir unlimited in capacity that may be made indestructible and impervious for all time, something cheap as to first cost and never needing repairs. The perfect reservoir is the underground cistern of concrete.

The first underground cisterns were always prone to leak. In wet weather the ground water seeped in and transformed the soft water into water as hard as that from the well. In dry weather such cisterns were empty. By means of concrete property owners are now able to build their own cisterns that are jointless, watertight and large enough to store an abundance of soft water even in the dryest season.



Section Through Cistern.

Concrete cisterns usually consist of two general types—underground and surface cisterns. The choice is dependent upon the amount of space available in the yard. Cisterns on top of the ground will be treated in a later issue.

Underground cisterns may be built in any shape desired. For the same amount of concrete, round cisterns (with a depth equal to the diameter) will hold the most water. However, since round forms are not easy to frame, most cisterns are made square. To illustrate the usual method of building, consider the construction of a cistern 8 by 8 by 8 feet in the chear, with walls 8 inches thick and with a capacity of 121 barrels. Before beginning the work, have all the materials on hand, slightly more than required.

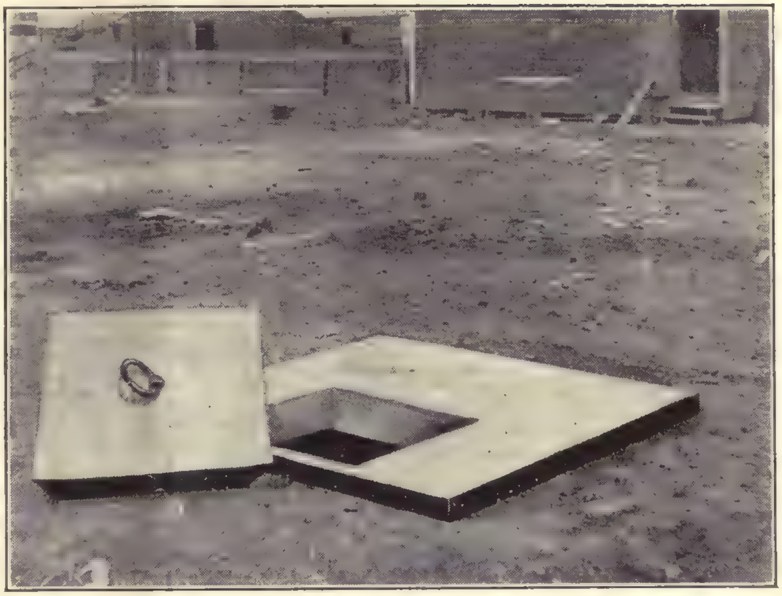
Locate the cistern in the most convenient place. Since the walls are 8 inches thick, lay out the hole 9 feet 4 inches square. The concrete bottom is 6 inches thick. Therefore dig the pit to the depth of 8 feet 6 inches. Since the concrete cover or platform will be 5 inches thick, the top of the cistern will be 5 inches above the ground, which is a desirable feature.

If the earth walls stand firm, only an inside form will be needed; otherwise make a similar form for the outside of the walls. This form should be built (each side separately) previous to digging the pit, so that it may be quickly erected and the cistern finished before a possible shower makes the hole muddy. For siding, use 1-inch boards on 2 by 4-inch uprights spaced 2 feet. As soon as the hole is dug, set up the forms on 6-inch cubes or brick of concrete, with 1-inch removable wedges between the forms and the bricks. The side wall forms will later support the platform on which the concrete cover will be built; and unless these wedges are used, the forms will bind and be difficult to remove. Join the forms at the corners so that they can be easily taken down after the cistern is finished. Against the earthen walls, and braced to the inside forms, set 1-inch boards, 12 inches wide, so as to prevent dirt from crumbling and falling into the cistern.

Mix the concrete 1 part Portland cement to 2 parts sand to 4 parts crushed rock. In measuring the quantities, consider 1 bag of cement equal to 1 cubic foot. If gravel is to be used, proportion the concrete 1 part cement to 4 parts clean gravel. For the floor have the concrete just wet enough to flush a little cement mortar to the surface when tamped into place. See that there is an abundance of mortar around the concrete blocks supporting the forms. Immediately begin filling the sidewall forms with concrete mixed mushy wet and place in

8 to 10-inch layers around the entire cistern. Be careful not to shovel the concrete against the earthen sides as dirt in concrete is liable to make a leaky wall. Do not stop until the forms are filled. At the proper points, insert an overflow opening (if desired) and a sewer pipe connection for the water from the downspout or the filter and the pipe connection for the pump in the house. This pipe should be carried 3 to 4 feet under ground, out of danger of freezing.

To keep out mice, vermin, scrub-water or filth, every cistern should be covered with a concrete platform reinforced with steel rods. After the concrete walls have been brought to ground level, set a wood frame around the outside of the cistern so as to hold the concrete for the 5-inch platform. To run water off the finished cistern cover, slope this frame 1-inch in the direction desired. Five inches below the finished top of the cistern cover construct a strong wooden platform of 1-inch boards for flooring. Build this on 2 by 4-inch joists nailed to the uprights of the side forms. This wooden platform will support the concrete cover until it is self-sustaining. To provide for a manhole opening take 1-inch boards 6 inches wide and build a bottomless box 5 inches deep, 2 feet square at the top and 18 inches square at the bottom—outside measurements. Another plan is to have the tinsmith make a round bottomless tin form 5 inches deep, 2 feet in diameter at the top and 18 inches at the bottom, after the pattern of a large dish pan without a bottom. Grease the manhole frame and set it on the platform where the opening to the cistern is desired. An iron manhole frame and cover can also be used. By a similar use of a section of a gas pipe or small drain tile, leave an opening for the pump stock, if an out-door pump is to be used. Around this opening in the soft concrete place bolts (washered) for the pump. To locate the bolts correctly, set them by means of a wooden block in which holes have been bored spaced exactly like those in the iron pump base.



View of Cistern Cover.

Over the entire platform, spread 1-inch of concrete. For reinforcing quickly place on this concrete 10-foot lengths of $\frac{3}{8}$-inch iron rods running in both directions (criss-cross) and spaced 1 foot apart. Bend the ends to

(Continued to page 1043.)

(Continued from Page 1041.)

a hook shape. Strengthen the platform around the manhole opening by placing two rods on each side. Bring the cover to its full thicknes by immediately tamping in the remaining 4 inches of concrete. Finish the surface with a wooden float (a trowel) the same as for sidewalks. If the tin form is used, the manhole cover may be cast at the same time as the remainder of the floor. Reinforce the cover with short length of iron rods laid crisscross. As a lifting ring for the cover, use half of an old bridle bit or a hitching post ring, the end provided with a knob of twisted wire or with a nut and large washer for holding it firmly in the concrete. If the wooden manhole form is used, carefully remove it after 5 hours. After 3 days build the manhole cover the same as for the tin form, with this exception —place greased paper or cardboard around the edge of the opening to prevent the new concrete from sticking to that of the platform. To make the manhole cover lighter in weight, before placing the concrete, spread 1½ inches of wet sand over the wooden platform in the manhole opening and then tamp in the concrete. Take care to place the reinforcing within 1 inch of the bottom of the manhole cover. When the cistern platform is two weeks old, remove the manhole cover and saw an opening in the wooden floor. Descend, knock out the 1-inch wedges under the side-wall forms, take the forms apart and pass them out through the manhole opening.

It is generally advisable to filter rain water. For this purpose provide a filter on the outside of the cistern proper. Construct this filter in the same way as the cistern was built except that the reinforced concrete cover should be loose so that it can be removed. Therefore, mold it on a smooth surface such as a wooden floor, and later put it in place. Make the concrete walls and bottom 6 inches and the cover 4 inches thick. Under most conditions a filter 2 feet square and 3 feet deep in the clear is large enough. Carry the walls a few inches above the surrounding ground. At the filter floor level connect the filter with the cistern by means of a 6 to 8-inch sewer pipe or drain tile laid with

(Continued to Page 1044.)

(Continued from Page 1043.)

carefully cemented mortar joints. Likewise, 1-foot from the top, lay a similar connection for the pipe leading to the downspout. Fill in 18 inches of coarse charcoal. Cover the charcoal with 6 inches of sand and gravel. Place the slab cover on the filter, and the cistern is ready for use.

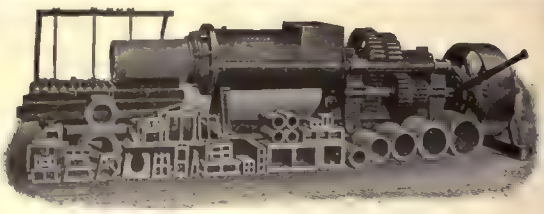
Below is given the amount of materials required for the cistern and filter. Since the prices given are liberal, by getting quotations from local dealers, the cost of the cistern may be found to be less.

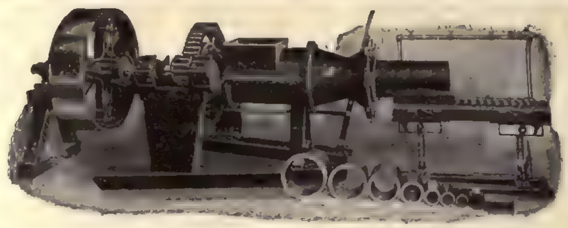
The cost estimate is as follows:

Crushed rock, 11 cu. yds., at $1.10	$12.10
Sand, 5½ cubic yards, at $1.00	5.50
Portland cement, 18 barrels, at $2.50	45.00
Reinforcement (18⅛"x10' rods), 93 lbs., at 2¼c.	2.10
Total	$64.70

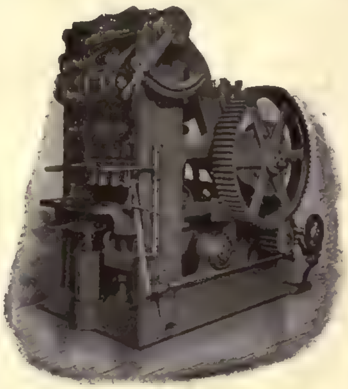
No estimate of the labor is given as the suburban or country dweller can easily build his own cistern with ordinary farm labor.

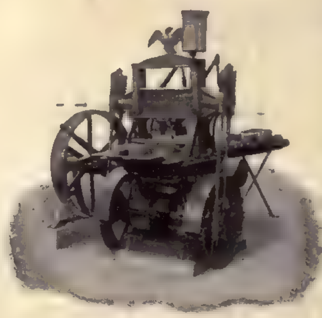
Send $1.00 for The Irrigation Age one year and the Primer of Irrigation, paper bound.


Centennial Auger Machine


Mascot Auger Machine


Wheelbarrows and Trucks


Dry Press, 5 styles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We build an entire line of Clay Working Machinery for the manufacture of Clay products by all processes, including Sand-Line Brick. Our yard supplies are the best. Kiln Irons, Cutting Wire and all supplies. Send for information or catalogue.

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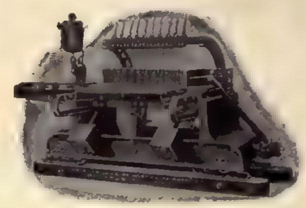
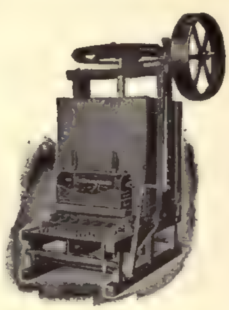
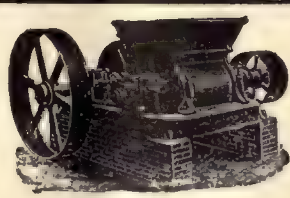
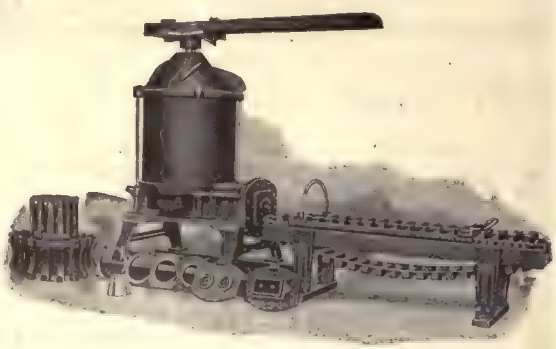

Hand and Power Cutters


Soft Mud Machines, Horse and Steam Power


Disintegrators


Hand Power Screw Press


Horse Power Plunger Machine


Products of our Auger Machines

Plow Deeper and Harrow Oftener—You Will Get Bigger Returns

Bigger returns mean more bushels; more bushels, more money; more money, more of the pleasures of life—***so make your farming more intensive.***

Deeper plowing loosens the fertility of lower soil strata, exposes a larger mass of soil to the air, improves the surface drainage, builds a deeper storage basin for water, gives the roots a better chance to grow and thereby makes healthier, stronger and better plants.

By pulverizing the soil more thoroughly and harrowing oftener a great deal more moisture can be locked up in the soil and the crops insured against drought.

The Better the Agriculture The More Power Required

The negro in the South has only the power of the mule, while the Iowa farmer has the power of three and one-half horses to aid him. But a more efficient, stronger and quicker power than horses is required nowadays to increase yields. Deeper plowing, more frequent and thorough harrowing can be done better, easier and with less expense with a tractor than with horses.

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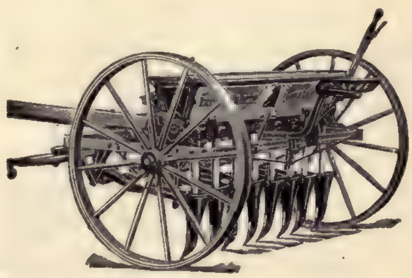

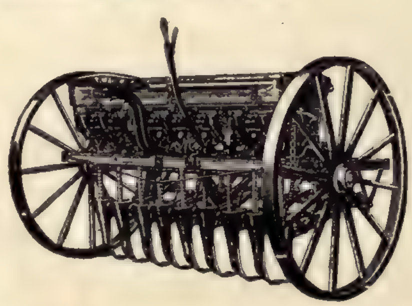

Twenty-sixth Year

THE IRRIGATION AGE

VOL. XXVI CHICAGO, SEPTEMBER, 1911. NO. 11

THE IRRIGATION AGE

With which is Merged

MODERN IRRIGATION THE DRAINAGE JOURNAL
THE IRRIGATION ERA MID-WEST
ARID AMERICA THE FARM HERALD

D. H. ANDERSON
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D. H. ANDERSON, Editor

ANNOUNCEMENT.

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CONTENTS.

Drouths Prove Blessings in Disguise.

The many crop failures which have occured on account of protracted drouths during the last few years in various parts of the United States, where the rainfall is supposed to be abundant and sufficient for all purposes have caused the affected farmers to do some hard thinking and to figure on ways and means of providing water for the growing crop when the rain supply fails. As a result, there is considerable activity in many sections of this country where individual farmers are working up schemes to provide a supply of water artificially, or in other words make some application of irrigation to supplement the rainfall or to entirely supply their growing crop with water at times when it is needed.

This new development along progressive lines cannot fail to have very beneficial results. How much water is running to waste for instance in almost any state through creeks and rivers, while the crops on the fields alongside are burning up for the want of it? In many cases a dam of a few logs thrown across a creek and a ditch cut from the reservoir thus formed will bring sufficient water on the fields or meadows to save the crops in case of drouth or to increase the yield to a considerable degree by irrigating at the required times.

Nor is it necessary that there should be a flowing creek at hand to engage in auxiliary irrigation, for anywhere, where water may be had by pumping and in reasonable quantities and at a reasonable elevation it will pay the farmer to install a pumping plant for the purpose.

Of course the details must be carefully figured out and planned. The lay of the land and the quality of the soil as well as the character of the crop to be raised must all be thoroughly considered. The question whether to use a windmill, a gasoline engine or a steam engine for the pumping of course depends on local condition and the quantity of water required as well as the area to be irrigated. Where winds are blowing frequently and with nearly uniform velocity the windmill offers the most economic solution of the problem since the cost of the power factor is eliminated. But where there are long and frequent periods of calm or very light winds the windmill may prove disastrous on account of its unreliability, and the artificial power plant, may it be an electrical, steam, gasoline or coal oil plant, will in most cases be the best paying for the reason, that they can be run when required thus providing the water when the crops need it without waste either by leakage or evaporation.

In most cases of this kind of irrigation it will be required to build some sort of reservoir at the highest point of the area to be irrigated, to pump into and from which the ditches should lead to the different fields. This will be particularly necessary when windmill power is used so that a certain amount of storage capacity is provided to be filled with water during periods of favorable winds. Also with power plants a storage reservoir is desirable, as that obviates the necessity of buying a large pumping plant.

Thus the drouths of the past years have really proven benefits in disguise and if the affected farmers go to work and develop the resources for irrigation at hand, they will soon reach the point where they will be in a measure independent of the regularity of the rainfall, since by the judicious use of their available water supply they will be able to give their growing crops enough of the life giving fluid at the proper time for their growth, so that crop failures will become less frequent all the time and finally cease altogether.

A Use For the Panama Canal Tools.

Congressman R. C. Wickliffe of Louisiana, has introduced a bill in Congress which provides that all dredges, tools and mechanical equipment used by the government in digging the Panama Canal be transferred as soon as the canal is finished, to the Secretary of War, who is to co-operate with the Secretary of the Interior in distributing such equipment, wherever it is needed for reclamation work throughout the United States.

Another Louisiana Congressman by the name of Dupre has already introduced a bill providing that all moneys obtained from the sale of public lands in the Southern States be set aside by the government for the reclamation of swamp lands in these states.

These two bills taken in conjunction, show that the people of the Southern States are very much in earnest regarding the drainage of their swamps and wet lands and are looking at the matter from the correct business standpoint inasmuch as they are willing that the money realized from reclaimed land should be made use of for further reclamations and that the equipment now in use in building the Panama Canal should be put to use on this reclamation work after the canal is completed.

It is, however, a doubtful proposition whether much help will be realized from the machinery now in use on the Isthmus for the reason that the type of dredges, steam shovels, etc., in use there, may not be adapted to the uses of reclamation. Also the canal will not be done for four more years and the reclamation should not be delayed pending such completion, though a good deal of the equipment will no doubt, be released long before the canal is finished.

The whole proposition is however, a pointer showing that the Southern swamps will be reclaimed in the near future for happy homes of prosperous farmers; that the government will undoubtedly take a hand in the execution of the problem, and that the machinery which has dug the Panama Canal will be used for some of the heavy work incident thereto.

The Changes of the Seasons.

The month of September forms the dividing line between summer and autumn, as on the 22nd of this month the sun reaches again the equator, making day and night equal for every place on the earth. After that the days will be getting shorter on the Northern Hemisphere, while our friends south of the equator will have longer days, and while we on the north half of this globe are approaching winter through fall, the people south of the equator are entering spring and approach summer which begins the 21st of December. Thus the changes of the season's occur with the utmost regularity like the vibrations of a pendulum, due to the motion of the earth around the sun, and the changed conditions at the various seasons are affected by the energy of the sun so that it may truly be said that this earth is entirely dependent upon the sun for its life and continued existence. It is the heat of the sun which makes the soil capable to sustain growing vegetation; the heat of the sun vaporizes the waters in the ocean and lakes and the winds carry them in the form of clouds over the country, bringing precipitation either in the form of rain, dew or snow, for the sustenance of the animal and vegetable kingdoms.

How beneficent the Creator has been in arranging the universe is seen at every point where we study a little into the conditions. The passing of the sun across the equator marks a splendid epoch in the design of this world's economics. During the months of June, July and August, the sun has given light and heat to every portion of the northern hemisphere, even as far north as Alaska and north of the Arctic circle, melting the heavy snows, thawing out and warming on the soil to make it receptive for the seeds to germinate and grow a crop for the sustenance of people and animals living on the northern hemisphere. The sun has not only given light and heat, but has also given longer days north of the equator, so that the work of the husbandman may be facilitated. The days have been the longer the farther north people are living, so that they may have longer sunlight to reimburse them for the shorter season. But now the crops are ripe and harvested, old Sol says good-bye to the north and travels south to perform the same service to our fellowmen on the southern half of the earth and while the crops are being placed in the soil there and gradually ripen, the lands of the north together with their cultivators, enjoy a well earned rest; until the sun, after having traveled south of the equator, on the 20th of March, crosses the line again and comes north to revivify nature and cause the bringing forth of further abundant crops.

Slow Increase in Number of Farms During Last Decade.

Perhaps one reason for the increased cost of living in recent years may be found in the fact, that the number of farms in the United states have by no means increased as fast as the population. This fact is disclosed by an advance statement of the census statistics recently issued by Census Director Durand. It appears that during the period 1900-1910, the population of the United States increased 21 per cent, while the number of farms grew from 5,737,372 in 1900 to 6,340,357 in 1910, an increase of 602,985, which is 10.5 per cent or just one half of that of the increase in population. This is the smallest increase recorded ever since the government included farm statistics into its census returns.

The small increase in the number of farms is by no means compensated by any growth in the size of farm area, or by an increase in acreage under cultivation. As a matter of fact, the average size of farms has decreased from 146 acres in 1900 to 138 acres in 1910, so that the actual area in farms in 1900 was 838,592,000 acres and in 1910 only 873,729,000, which is an increase of 35,173,000 acres or 4.2 per cent.

The acreage of improved land however increased at a more favorable rate, the advance being from 414,499,000 acres in 1900, to 477,448,000 acres in 1910, a gain of 62,949,000 acres or 15.2 per cent in 10 years. Still the increase is only about two-thirds of the increase in population, showing that there is a deficiency in the acreage producing crops for the support of our population.

As a contrast to the slow growth of the farms, the increase in farm values is something tremendous; farm land, exclusive of buildings in 1900 were valued at $13,058,008,000, while in 1910 they were valued at $28,386,770,000, which is an increase of 117.4 per cent, or the value has more than doubled. Thus the average value per acre has increased from $15.57 to $32.49, which is a gain of $16.92 per acre.

There are many reasons why farm lands should show a marked increase in value. To begin with in 1900, the average valuation of farm land was undoubtedly taken too low and a heavy increase should naturally be looked for. Then the gradually increasing prices of farm products would enhance the value of the land since the income derived from an investment in farming land would show an increasing rate of earning capacity. Then actual improvements such as the irrigation of dry lands, the drainage of swamps, the tiling and surface drains for wet lands, the clearing of land, removing brush, stumps and stones, the building of fences have all tended to raise the value of the land, so that the value as given in the census report is probably near the actual values.

Another interesting fact is disclosed by the census and this is that in 1900 the city population formed 40.5 per cent of the total population of the country; in 1910 this has raised to 46.3 per cent, indicating that nearly half of the population of the United States is living in cities and towns, pursuing other than agricultural vocations.

This presages that there will be ere long, another exodus from the city to the country, from the factory to the farm, as the balance of population must adjust itself sooner or later to a more adaptable proportion since it looks absurd that one half of the people should be crowded into towns while the other half would reap big financial returns from raising and selling crops to feed their city cousins. A ratio of two to one, that is, have a rural population twice as large as the urban population, would prove a blessing all around, would benefit the country, as well as the cities. The "Back to the Farm" slogan should be encouraged.

Thoughts That Come and Go.

After all the crop reports are in and analyzed it is seen that the returns have not been so bad after all and that it might have been much worse.

* * *

It must be something of a satisfaction that much of the shortage in potatoes this year will be relieved by the crop grown on irrigated lands, bringing financial returns to the irrigator and good potatoes to the dwellers in the east and middle west.

* * *

The irrigator has shown again the "rain farmer" that rain is all right when it comes at the right time, but water in the ditch is more reliable.

* * *

This issue contains a condensed statement of the irrigation statistics of the states of North Dakota, South Dakota, Arizona and Washington. The information given has been gathered by the government as part of the Federal census and is therefore entirely reliable.

* * *

Don't overlook the date when you should renew your subscription to Irrigation Age. The date is plainly marked on the cover in which the paper is mailed to you.

* * *

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* * *

The Missouri College of Agriculture is moving in the right direction by offering courses in agriculture to women. By educating both the man and woman for this noble calling, success ought to be certain.

* * *

Another land drawing in South Dakota is scheduled for October 24, the registrations beginning October 2, and closing October 21. Land is getting scarcer all the time and there will be heavy competition.

* * *

A description of Mount McKinley apears elsewhere in this issue and it may be inferred by the report of Mr. Brooks, who made a survey of the mountain, that it would be a very difficult task to climb to the summit of this Alaskan giant, towering 20,300 feet above the ocean.

* * *

The Primer of Irrigation and the Primer of Hydraulics, both cloth bound, can be had for $3.50, by sending to the Irrigation Age. These two books cover practically all the irrigator needs to know about the scientific part of his work.

* * *

The Primer of Hydraulics will be ready for distribution about January 1, 1912; single copies cloth bound, $2.50, with one year's subscription to Irrigation Age, $3.00: one copy of each of Primer of Hydraulics and Primer of Irrigation with one year's subscription to the Irrigation Age for $4.00. Send all remittances to Irrigation Age, Chicago.

The Cienega Sub-Surface Dam Near Tucson, Arizona

By G. P. E. Smith*

In the irrigated sections of the west many streams are popularly believed to carry considerable quantities of underflow and in many places subsurface dams have been projected or discussed for the purpose of intercepting the underflow and raising it to the surface. Few such dams, however, have been built, notable exceptions being those of Pacoima Wash in California and Agua Fria River in Arizona.

An account of such a structure is of interest in two ways: First, the design is required to meet unique conditions; and second, the amount of water recovered contributes to our knowledge of the underflow of stream.

At the head of the Cienega Ranch irrigating ditch, near Tucson, the conditions appeared to be favorable to the construction of a subsurface dam. The river here narrows between hard sandstone walls to a width of 67 feet, and the traditions of the locality were that bedrock was reached by sounding rods at a maximum depth of 12 feet. The gradient of the river is 41 feet per mile, the summer floods are sudden and torrential and the great difficulty of maintaining an ordinary ditch head against the severe floods occurring every summer made it desirable to take the water out through a pipe conduit laid at a safe depth below the river bed. It was expected also that a considerable volume of underflow would be recovered.

The construction of the dam, conduit and collecting basin has been carried out during the spring of 1911. The surface flow was very small and the danger of floods at that season of the year was negligible. The excavation of the river, gravel, was carried down to a depth of 25 feet with slip scrapers. At that depth the width of the river bed between rock walls was 22 feet and a trench with lagging was started, its cross width being 12 feet, narrowing to 9 feet when bedrock was finally uncovered for the full width of the river bed.

In order to keep down the seepage water during the excavation and construction centrifugal pumps were used, the combined discharge for several weeks approximating 4 second-feet, due in part to the draining out of the sand reservoir above the site.

The dam is of the arch type as shown by Fig. 1, and is built of plain concrete. The upstream face is vertical and the radius of curvature is equal to the span length, 67 feet. The top width is 14 inches, and the bottom width at the extreme depth of 45 feet 6 inches is 5 feet. A view of the completed structure is seen in Fig. 2.

The concrete was proportioned 1 cement to 5 of river gravel and boulders were driven into the mushy mixture after it was placed in the forms. The concrete was bonded to the rock surface with neat cement. On the sides of the cañon the rock face was blasted off so as to form a square skewback to take the thrust of the arch. The elevation of the top is that of the normal river bed. Six days sufficed for the concreting, part of the form work being done at night.

Whether or not the structure as built will withstand the floods has not been proven as yet. If the top portion should fail, the upper 6 or 8 feet can be rebuilt of reinforced concrete and with sufficiently heavy section so that it will be permanent.

Upstream from the dam, as seen in the plan, Fig. 1, is a concrete cylinder of 8 feet inside diameter and 25 feet depth, to serve as a collecting head. Its thickness is 8 inches. The inflow is upward from the bottom and laterally through 200 holes each 2 inches in diameter and protected by coarse ¼-inch mesh screen. The conduit of 16-inch cement pipe is started at the bottom of the cylinder and is laid on a level for 50 feet, thence on an upward incline for 250 feet to the Cienega ditch, the bottom of which is 4 feet lower than the river bed. The cement pipe was 1½ inches thick and under the pressure head of 22 feet leaked badly at first, but has slowly improved in that respect.

The surface flow of water one-fourth mile above the site on June 8 was 0.6 second-foot and the ditch was carrying 1.5 second-feet, the underflow thus added being approximately 1 second-foot. On previous years the flow at the ranch at this season has been about one-half of a second-foot in the morning and the ditch has been dry at evening, due to the extremely high rate of evaporation during the day.

The improvements were designed and successfully constructed by Mr. R. R. Schweitzer, manager of La Cienega Land & Cattle Co. The total cost, including labor, supervision, supplies, rent of pumping machinery, and cement at $3.15 per barrel, was $7,350. A second-foot of water used for fruit and alfalfa ranching at Tucson can be capitalized at $18,000.—*Engineering & Contracting.*

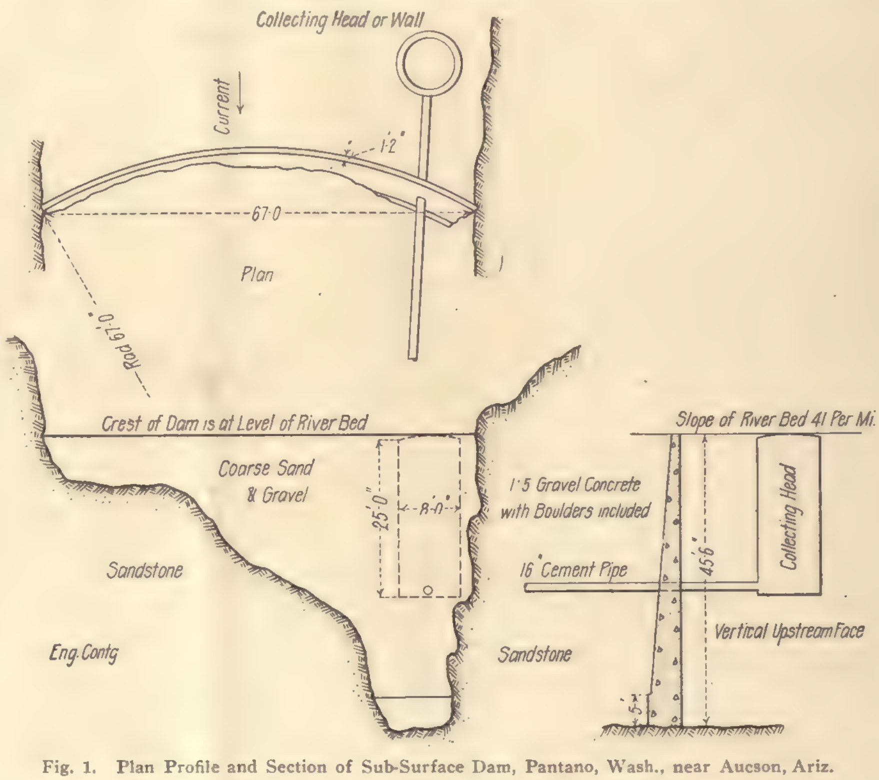


Fig. 1. Plan Profile and Section of Sub-Surface Dam, Pantano, Wash., near Aucson, Ariz.

George Austin, John Henry Smith, M. H. Walker, Seymour B. Young and Fred J. Kiesel constitute the committee appointed by Governor William Spry to represent Utah at the National Irrigation Congress to be held at Chicago December 5-9. The committee will work in conjunction with the executive committee of the congress.

It was stated recently by Samuel Fortier of the Government Agricultural Department that the Weber and Davis canal of Ogden is far ahead of the majority of big irrigation projects in the west, both in point of efficiency and accomplishments in engineering.

*Irrigatoin Engineer, Agricultural Experiment Station, University of Arizona, Tucson, Arizona.

WASHINGTON'S IRRIGATION STATISTICS.

Acting Census Director Falkner has issued the first official statement from the Census Bureau relative to the statistics of irrigation in the state of Washington.

It is based on a preliminary comparative summary submitted by Dr. Le Grand Powers, chief statistician of the division of agriculture in the Bureau of Census, under whose supervision it was prepared bv R. P. Teele, special agent in charge of irrigation. This summary shows for both 1909 and 1899 the number of farms irrigated, the acreage irrigated, the acreage which existing enterprises are capable of supplying and the acreage included in existing projects, the number of independent enterprises, the length of main ditches, the total cost of irrigation systems, the average cost per acre irrigated, and the average annual cost of maintenance and operation. It shows also, for the year 1909, length of lateral ditches, number of reservoirs, capacity of reservoirs, number of flowing wells, number of wells pumped for irrigation, number of pumping plants, engine capacity of pumping plants, and acreage irrigated with pumped water. The acreage irrigated is classified by the type of enterprise supplying water and by the source of water supply.

The act of Congress of February 25, 1910, under which the census of irrigation is being taken, provides for collecting full information concerning the location, character and cost of irrigation enterprises; whether such enterprises are conducted under national, state or private control; the acreage of land irrigated; the prices at which land with water rights can be obtained; and the quantity of water used for irrigation.

It should be noted that the figures are subject to revision after more complete tabulation, but it is not expected that there will be any material modification of the totals or percentages reported.

The total number of farms irrigated in 1909 was 7,405, against 3,513 in 1899, an increase of 3,892, or 110.8 per cent. This rate of increase is considerably higher than that in the whole number of farms in the states, showing that irrigation is advancing more rapidly than dry farming.

The total acreage irrigated in 1909 was 334,378 acres, against 135,470 acres in 1899, an increase of 198,908 acres, or 146.8 per cent. During the same period the improved land in farms increased but 83.3 per cent, showing that a considerably larger part of the improved area was irrigated in 1909. The per cent of the improved area irrigated increased from 3.9 in 1899 to 5.3 in 1900.

The total acreage which all enterprises were capable of supplying with water in 1910 amounted to 470,514 acres, an excess of 136,135 acres over the area irrigated in 1909. The total acreage reported in projects in 1910 was 817,032 acres, an excess of 482,654 acres over the area irrigated in 1909. This indicates in a general way the area which will be available for settlement within the next few years.

The number of independent enterprises was 1,933 in 1909 and 878 in 1899, an increase of 1,055, or 120.2 per cent. The total length of main ditches was 2,558 miles in 1909 and 806 in 1899, an increase of 1,752 miles, or 217.4 per cent. In 1909 there were 156 reservoirs, having a capacity of 121,543 acre-feet.

The total cost of irrigation systems to July 1, 1910, was reported as $15,014,090, as against $1,722,369 in 1899, an increase of $13,291,721, or 771.7 per cent. The average cost of irrigation systems per acre irrigated in 1910 was $31.91, as compared with a cost of $12.56 in 1899, an increase of $19.35, or 154.1 per cent.

The average annual cost per acre for maintenance and operation in 1909 was $3.08. This was not reported in 1899.

The acreage irrigated in 1909 has been classified according to the state and Federal laws under which the works were built or are operated, as follows: United States Reclamation Service (act of Congress, June 17, 1902), 55,690 acres, or 16.7 per cent of total; United States Indian Service (various acts of Congress), 35,000 acres, or 10.5 per cent of total; co-operative enterprises, 81,122 acres, or 24.3 per cent of total; enterprises supplying water for hire, 66,911 acres, or 20 per cent of total; private and partnership enterprises, 95,655 acres, or 28.6 per cent of total. There are no Carey Act or irrigation district enterprises in the state. Of the 55,690 acres reported as irrigated by the United States Reclamation Service, 49,979 acres is reported as having been irrigated by works built by others and taken over by the United States Reclamation Service. Works built by the United States Reclamation Service are to be turned over to the water users for operation and maintenance. Including these, 69.6 per cent of the acreage irrigated in 1909 was supplied by works controlled by the water-users.

Streams supply 310,426 acres, or 92.8 per cent of the total acreage irrigated in 1909; lakes supply 10,782 acres, or 3.2 per cent; well supply 8,664 acres, or 2.6 per cent;

NEW INCORPORATIONS.

The McGhie Irrigation Company has recently been formed to take over and extend the McGhie Irrigation ditch near Butler, Salt Lake County, Utah. Capital stock, $9,270, divided into shares of $18.00 each. Wm. McGhie, president; John McGhie, vice-president; Thomas McGhie, secretary and treasurer. These officers constitute the directorate.

Fig. 2. View of Sub-Surface Dam and Collecting Head.

The Utah Rivers Investment Company has filed articles of incorporation with the county clerk, Salt Lake City, Utah, to engage in a general land and irrigation business. Capital stock $10,000. The officers of the corporation are Frederick Steigmeyer, president and treasurer; Max Brown, vice-president; James Wolfe, secretary.

Articles of incorporation have been filed in the territorial secretary's office by the Gallinas Irrigation Land Company, which will have its main offices in Las Vegas, New Mexico, and names Stephen B. Davis, Jr., as its statutory agent. The company is capitalized at $50,000 and consists of 500 shares at $100 each.

Present Status of the Reclamation Work of the Government Projects

Arizona, Salt River Project (91.7 *per cent completed*).—Labor and weather conditions were favorable throughout the month. At Roosevelt the work of wiring the benchboards, installing equipment in the 2,300-volt switchroom at the power house, finishing the cable span from the transformer house to the power house, and installing the cables connecting the cable spans with the switches was continued. The development of battery E wells in the Chandler district was nearly completed and the wells tested with satisfactory results. The equipment was moved to battery F in the same district and excavation carried on with good progress. The first well near the San Francisco canal was finished and tested. The test indicated satisfactory water bearing material. Preliminary work was commenced on the building of the transmission line from the Chandler district to Tempe and to the San Francisco well. Enlargement of the Arizona canal with dredge and excavator, both working in rock, was continued with fair progress. A large force made good progress on the construction of the Western canal and necessary feeders on the south side. Constant water service was maintained throughout the system, with the exception that on account of cleaning canals and repairing structures water was not run in the Grand canal from the 7th to the 13th, inclusive, nor in the Eastern canal until the 4th of the month. The usual maintenance work was carried on. The flow of the river remained practically constant and the sluice gates at the reservoir were closed, the necessary water supply being furnished through tunnel No. 2, the discharge ranging from 1,155 to 1,449 second-feet. The total amount of water drawn from the reservoir was 52,880 acre-feet, causing a drop of 5.45 feet in elevation.

Arizona-California, Yuma Project (52.4 *per cent completed*).—At Laguna dam no work was done on the Arizona side of the river. A small force was employed on the California side in getting out rock from the quarry to protect the banks of the spillway below the sluicegates and in making repairs. The excavation of canals on the Arizona side of the river below Laguna dam and the construction of levees in the lower Yuma Valley were continued with good progress. The construction of the main canal between the California shaft of the Colorado siphon and a point three and one-half miles above was practically completed on June 23, and the stock engaged on the work was then released. With the aid of the steamer Searchlight, a pile driver was operated in protecting the river bank from ten to twelve miles below Yuma. Satisfactory progress was made, and the encroachment of the river at this point was effectually stopped. The installation of the pneumatic plant for the construction of the Colorado siphon, commenced on May 31, was completed on June 19, when air pressure was placed on the Arizona shaft. After that date the work was carried on steadily with three shifts, an air pressure of about twenty pounds being maintained. Three cuts were made through the walls of the shaft, and operating from these cuts a tunnel will be driven entirely around the structure. In this tunnel a water seal will be introduced to shut off the ground water from above, and when this has been completed the water will be lowered to the bottom of the shaft and tunneling operations commenced. On the Indian reservation water was supplied throughout the entire system during the month. The farmers' pump, the scoop wheel and the Rollins pump were operated throughout the month, furnishing water for about 7,000 acres of land. Topographic surveys and resurveys of section lines in the lower Yuma Valley and canal location surveys along the east side of the valley from Yuma to the international boundary were carried on. On the Indian reservation the location of the main canal between the power house site and Laguna dam was continued. On the Arizona side of the river a few miles below Laguna topographic surveys and resurveys of section lines were carried on. The discharge of the Colorado River ranged during the month from 50,300 to 78,300 second-feet. At the end of the month the gage height was 25.5 and the discharge about 70,000 second-feet. The flood apparently reached its crest on June 24, when the maximum discharge of 78,300 second-feet occurred.

California, Orland Project (81 *per cent completed*).—Regular delivery of water for irrigation was maintained, 7,000 acre-feet being diverted from Stony Creek, about 4,000 acre-feet of which was turned into the distribution system, the balance being used for priming laterals not in present use and wasted through the spillways. Surveys were continued for a canal diverting on the north side of the river at the Miller Buttes headworks. A survey of the irrigated lands and the gaging of the various private ditches diverting water above the south side heading were continued throughout the month. Applications were received for rental of water for 2,544 acres of land. Evaporation pans were installed at East Park. Forty-one thousand acre-feet of water were stored at East Park reservoir at the end of the month. An alfalfa meal mill, with a capacity of 35 tons per day, is being constructed with local capital, the main building, which is to receive the machinery, being nearly completed. A jubilee to celebrate the completion of the distributing system of the Orland unit was held on the 16th and 17th of the month. It was successfully managed, and resulted in bringing to the project a great many visitors, who were cordially welcomed and entertained.

Colorado, Grand Valley Project.—Detailed topographic maps showing the location of the Price ditch in the Palisade Irrigation District were made during the month. On these maps a location was projected for a canal proposed in another alternative plan for the project. This plan involves the use of two main distributing canals, one to be built along the line of the present Price ditch and the other along and above the line of the present Stubb ditch. Right of way plats for the Price line were prepared. Routine hydrographic records of the Grand River and the irrigation ditches in the valley were continued.

Colorado, Uncompahgre Valley Project (50.7 *per cent completed*).—Work was continued throughout the month on the erection of the Maginnis galvanized steel flumes on the King lateral extension. Flumes 9, 10 and 11 were completed. The excavation of trench for the High Mesa siphon was completed, 2,613 feet being excavated during the month, and the hauling of the 26-inch ingot iron pipe for the siphon was begun during the latter part of the month. The laying of the 1,416 linear feet of 36-inch riveted steel pipe for the Dry Creek siphon was completed and the trench backfilled, except at the location of pipe joints. The concrete inlet, outlet and wasteway for the Dry Creek siphon were completed. The excavation of the Spring Creek canal, having a capacity of 20 second-feet, was begun, the excavation being completed from station 177 + 85 to station 288 + 16. The Coal Creek dike, 550 feet long, was built to protect the Montrose and Delta canal headworks at the point of diversion from Coal Creek. The surveys for the east and west canals were completed. High water prevailed in the Uncompahgre River throughout the month, making it unnecessary to carry a large head through the Gunnison tunnel. During the month 16,560 acre-feet of water were supplied for irrigation through the Montrose and Delta canal, 6,780 acre-feet through the Loutsenhizer canal, and 1,500 acre-feet through the Gunnison tunnel and South Canal. It was necessary to shut down the Montrose and Delta canal for a period of two and a half days during the month in order to remove gravel deposits which had accumulated during high water. A small flow of water was carried in the King lateral for five miles in order to settle its banks and test the canal.

Idaho, Boise Project (*exclusive of Boise River Storage*, 74 *per cent completed; storage unit* 3.6 *per cent completed*).—The excavation of the large gravel cut on the main canal was completed during the month, but no work was done on the principal contract for enlarging the canal. The construction of the Deer Flat Forest embankment by force account was completed on June 21, and the placing of a gravel facing on the lower Deer Flat embankment was then commenced. Progress was made in assembling the plant for the construction of the Forest concrete pipe line. The construction of the Mora and Dempke wood stave pipe lines was brought to about 90 per cent completion. The contractors for excavating the lateral system made good progress, and the construction of the lateral structures by force account was continued with excellent progress. At the end of the month there were stored in the Deer Flat reservoir approximately 77,000 acre-feet of water, corresponding to a depth of 15.9 feet over the gate sills of the outlets. At the end of the month there had been received 1,016 applications for water, amounting in rental value to $30,960; and water was delivered from the various canals in operation throughout the entire month. The prospects for crops on the project are excellent.

On the Boise River storage unit diamond drill borings at the Arrowrock dam site were completed. The manufacture and hauling of lumber and the erection of the camp buildings were continued with satisfactory progress. The wagon road around the reservoir was nearly completed as far as Cottonwood Creek. The relocation of the Bell telephone line around the reservoir was continued with satisfactory progress. Good progress was made in the grading of the first nine miles of the railroad to the dam site, and the contract was awarded for the remainder of the work. Ties, rails and track materials were received and hauled to the work, and the laying of track was commenced. The construction of the diversion works at the site of the dam was begun. Preparations for the construction of the power house and movable crest at the Boise diversion dam were commenced, and work on designs and estimates was continued.

Idaho, Minidoka Project (*gravity unit completed; south side pumping unit* 94 *per cent completed*).—At the power house, power unit No. 4 was completed during the month, and five power units were in operation at the end of the month. There was considerably greater demand for water on the pumping unit, and water was supplied to approximately 20,000 acres of land. The delivery of water throughout the month, with but few exceptions, was constant on both the gravity and pumping units of the project.

Montana, Blackfeet Project (*Two Medicine unit* 47 *per cent completed*).—Weather conditions were favorable. An average force of 77 Indian laborers and 178 Indian teams was employed on the project during the month. Excavation of the main canal on the Two Medicine unit between mile posts 26 and 27 was finished, thereby nearly completing the main canal excavation. Approximately 15 miles of laterals were completed on the distributing system of this unit. An operation force was organized and water was turned into the first three miles of the canal. Preparations were continued for the construction of the lower Two Medicine Lake dam. Approximately 75,000 cubic yards of material were removed from about three miles of the feeder canal for the Badger-Fisher unit.

Montana, Flathead Project (*Jocko division* 67 *per cent completed; Mission division* 8 *per cent completed; Pablo division* 17.4 *per cent completed; Polson division* 8.6 *per cent completed; Post division* 24 *per cent completed*).—In Jocko division a force of about 40 men, employing 40 head of stock, continued excavation on the Finley Creek canal. In Pablo division the excavation on the feeder canal was continued with the Atlantic steam shovel until the 18th, when the shovel was laid up for general repairs, including a new car body and new boiler. It is now 7.7 miles from Post Creek, its objective point, 15.2 miles of progress having been made since July 1, 1910. At the Pablo dam site the outlet culvert of the controlling works was completed and progress was made on the gate tower. A drop into the middle of the Pablo reservoir and excavation for three other drops were completed. The government forces working with teams on the Pablo feeder canal completed the excavation to within 1¾ miles of north Pablo reservoir, where it is proposed to begin contract work. In Polson division 50 linear feet of Newell tunnel were driven through very hard quartzite, progress being impeded somewhat by the presence of water. In Post division the Bucyrus steam shovel made 1½ miles progress on the Kicking Horse feeder canal, casting most of the material over the bank. About three-eighths of a mile remains to be excavated in order to reach Post Creek. Some wagon hauling was done in the larger fills after passing Marsh Creek. The Ninepipe dam was practically completed up to the height proposed for present construction, giving a reservoir capacity of about 5,000 acre-feet. Some finishing and a small amount of riprapping remains to be done. Two concrete drops with a capacity of 80 second-feet each on Post D canal and a number of minor bridges, turnouts, etc., were built. Excavation was completed for a drop of 400 second-feet capacity on the Kicking Horse feeder canal. The precipitation up to the 24th of the month amounted to 3.24 inches. Water was high in all streams, and about 1,000 acre-feet were stored in Ninepipe reservoir. Thirteen farmers have begun irrigation and twenty-three have applied for water on 2,539 acres. The chief duties of the canal rider were the installation of weirs and gages and getting ready for the irrigation season.

Montana, Fort Peck Project.—A maximum of 230 Indian teams and 200 Indian laborers were employed on excavation, the number being reduced during the latter part of the month to about 100 teams and 100 men. The excavation of the laterals for the B unit was continued with a Reclamation ditcher, nine miles of laterals being constructed during the month. The diversion dam was completed on June 10. The flume over the coulee at station B-268 was completed and the flume at station B-347 was 80 per cent completed. About one-half of the farm turnouts for the B unit were completed.

Montana, Huntley Project (96 *per cent completed*).—The weather throughout the month was moderately warm, with a total precipitation of 3.05 inches. Only a small quantity of water was used for irrigation. The crop outlook for the season is good. The first crop of alfalfa was cut and most of it stacked. Notwithstanding the very dry spring, there was an exceptionally good stand of sugar beets and small grains on the project.

Montana, Milk River Project (12 *per cent completed*).—Work under the last of the contracts for excavation of laterals on the first unit under the Dodson south canal was completed June 22. Plans and specifications for construction work on the first unit under the Dodson north canal and extension of the Dodson south canal were prepared. The flow in Milk River was very low the early part of the month, but beginning on June 28 increased rapidly until the end of the month about 1,500 second-feet were flowing over Dodson dam. During the early part of the month little water was delivered, but beginning about the 20th requests for water were received and deliveries made for irrigating grain. Water was supplied to 2,000 acres of land covered by water rental contracts on the first unit under the Dodson south canal. Crops under irrigation were in excellent condition, and in most cases the first crop of alfalfa was harvested. No progress was made in settlement, as public notice announcing the opening of the first unit of the project has not yet been issued.

In the vicinity of Saint Mary Lakes the precipitation during the month amounted to 2.6 inches and the temperature ranged from 38° to 80° F. The discharge from the lake ranged from 2,000 to 2,500 second-feet. Topographic surveys were continued on the west side alternative location of the main canal and studies of the canal and structures were carried on. A board of engineers visited the unit on June 24 to consider the advisability of changing the location of the first six miles of the canal to the west side of the Saint Mary River, but no report has been received.

Montana, Sun River Project (8 *per cent completed; Fort Shaw unit completed*).—At Willow Creek dam the steam shovel was under repairs until the 16th, when it was again placed in operation. The use of donkey engines and cars on this work was discontinued, the material being placed in the dam by means of teams and dump wagons. The earthwork in the dam is 62 per cent completed. One thousand one hundred acre-feet of water were stored in Willow Creek reservoir at the end of the month. At Sun River Canyon dam site a diamond drill was in operation throughout the month. Surveys were begun for a wagon road from Sun River Canyon to Warm Springs. On the Teton unit topographic surveys of irrigable lands were continued. On the Fort Shaw unit the weather conditions were suitable for crops, and the indications were that a good yield would be forthcoming. The precipitation during the month amounted to 2.5 inches. Water was furnished to 99 public farm units and 5 farm units in private ownership.

Montana-North Dakota, Lower Yellowstone Project (95 *per cent completed*).—Construction and repair work carried on during the month consisted mainly in building necessary laterals, installing turnouts and checks, repairing and placing culverts, and repairing the banks of numerous laterals. Approximately 30 head ditches were laid out for land owners who will irrigate this season; 1,050 linear feet of laterals were constructed, necessitating the removal of about 3,425 cubic yards of earth; and the banks of laterals were raised from 8 to 12 inches for a total length of 5,600 feet, 550 cubic yards of earth and gravel being required. At the end of the month requests for water had been received covering 15,422 acres under the first unit. No difficulty was experienced in supplying all demands. Weather conditions were favorable during the month, the temperature ranging from 34° to 102° F., and the precipitation amounted to 2.8 inches.

Nebraska-Wyoming, North Platte Project (*Pathfinder and Interstate units, taken together,* 78 *per cent completed*).—Weather conditions were favorable for construction work and farming operations throughout the month. Rain fell generally over the entire project on the 15th and 16th, varying in depth from .5 to 3 inches. The canal system was successfully

operated during the month. No breaks occurred and the water supply was sufficient. The amount of water diverted into the main canal varied from 1,130 to 1,285 second-feet. Water was delivered to about 650 users. About 45,000 acres of land were under cultivation, including about 10,000 acres of old alfalfa land, but no wild hay land. On the first division of the main canal and in the first and second lateral districts no construction work was done, and the engineering work consisted of stream gaging and minor work. In the third lateral district contracts were awarded for the excavation of about 63,000 cubic yards on laterals 28a to 33 main and work was commenced. Work on the high line canal was continued, all schedules excepting 37 and 38 being completed. Work was also continued on the excavation of lateral 28. Force account work was in progress on dam 1½, West Winter Creek siphon, and several minor structures. Plans and specifications were under preparation for dams 1, 2 and 3 and for control works for the same. On Goshen Park and Fort Laramie units the preparation of estimates and the drilling at the Guernsey dam site were continued. At the Pathfinder reservoir the hauling of sand for use next fall in concrete at the south tunnel was in progress and the work was practically finished. On June 26 the reservoir contained 380,000 acre-feet of water.

Nevada, Truckee-Carson Project.—At Lahontan dam construction work included steam shovel excavation in the foundation trench for the outlet conduit and for the left spillway. At the forebay for the power plant the placing of concrete lining and the construction of the headwall and the penstock headworks were continued. Excavation for the cableway tower tracks was completed and work preparatory to the installation of plant was carried on. About 160 men and 60 head of stock were employed throughout the month. The distribution system was operated throughout the month, supplying a large demand for irrigation water. Both rivers were in flood condition, but no material damage resulted. Due to the unseasonably cool weather during May, crops were retarded two or three weeks at the beginning of the month, but warm weather set in during June and crops made good progress in growth. Sugar beets and potatoes were planted to a considerable extent.

New Mexico, Carlsbad Project (completed).—Heavy rains occurred during the month. A small flood in the vicinity of Cass Draw damaged the canal banks and necessitated the placing of about 600 cubic yards of earth to repair the damage. On June 11 water was turned out of the canal for twelve days to kill moss and weeds. George B. Richardson, geologist, visited the project on June 11 to investigate a third reservoir site, as proposed by the water users' association; no report upon this has as yet been received. Seventy carloads of alfalfa have been shipped from the project and a considerable quantity has been stored by the farmers.

New Mexico, Hondo Project (completed).—Considerable land was irrigated during the month and the first crop of alfalfa was cut. At the end of the month there was no water in the reservoir.

New Mexico-Texas, Rio Grande Project (preliminary work; Leasburg unit completed).—Work at Elephant Butte was carried on during the month with satisfactory progress. Tracks and switches were laid in the terminal yards, leveling for the cable towers was continued, and work on the permanent Engle road was carried on. The construction of the flume was continued with good progress. Three derricks were received for this work and were set up. Telephone communication was extended over the works, more cottages were built for the mechanics, and the headquarters mess was about completed. Work was continued on the hospital building, corral building at the lower townsite, and officers' quarters. The erection of the bridge over the river by contract was practically completed. The supervising engineer spent three days at Elephant Butte and the chief electrical engineer has been in consultation with the contractor who is to erect the power plant. Forty-five carloads of materials and supplies and eleven local shipments were received over the railroad during the month. Canal surveys between Las Cruces, New Mexico, and El Paso, Texas, were commenced.

On the Leasburg unit operation and maintenance was continued. The river was in flood during the month, with a discharge of from 2,000 to 5,000 second-feet. A small cloudburst occurred near the head of the Leasburg canal and considerable sand and gravel was washed into the canal from small arroyos. About 300 cubic yards of material were removed in making the necessary repairs.

North Dakota, Missouri River Pumping Project (Buford-Trenton unit 38 *per cent completed; Williston unit* 64 *per cent completed).*—The Missouri River rose about 6 feet during the month. The precipitation amounted to 1.23 inches. The land owners under the Buford-Trenton unit met the requirements of the secretary's order of May 13, and operation was started June 20, water deliveries being made to six farm units. On the Williston unit operation was commenced June 3, water deliveries being made to 52 farm units. About 5,000 acres of land, nearly all of which were under cultivation, were entitled to delivery of water. Crops under irrigation are in excellent condition, and the cutting of the first crop of alfalfa was well under way.

Oregon, Umatilla Project.—Weather conditions were favorable except for strong and persistent winds. The maximum temperature was 102° and the minimum 36° F. The delivery of water to the reservoir ceased June 17, and the lining of portions of the feed canal was begun. The total quantity of water diverted from the river through the feed canal during the month was 4,700 acre-feet, of which 3,200 acre-feet reached the reservoir. Nine thousand five hundred acre-feet of water were turned out from the reservoir to the distribution system, and 1,500 acre-feet were diverted from the river through the Maxwell canal. The available storage in the reservoir at the end of the month amounted to 41,000 acre-feet. At the end of the month water-right applications had been received covering 12,675 acres of land.

Oregon-California, Klamath Project (45 per cent completed).—Crops are looking well, except in places where high winds have blown the soil over part of the grain. Water service was continued throughout the project without unusual incident, and water was turned into the Ankeny canal about June 27. The force at work on Lost River diversion channel, schedules 2, 3 and 4, was increased, and had nearly reached the schedule requirements by the end of June. Work on Schedule 1 was continued with satisfactory progress. Good progress was made on concrete work at the Lost River diversion dam, foundations for about one-third of the piers, the upstream cut-off wall, and portions of the heavy retaining walls on the north side of the river being completed. The contractor had two barges in use on the main canal freighting sand, cement, etc., from the railroad siding to a point on the East Branch canal two miles from his work. This water transportation has greatly facilitated the handling of freight. The cut-off trench under the south embankment has been excavated to solid material and has been refilled about to the elevation of the original surface. Excavation of the drain with the Lidgerwood excavator was continued with somewhat better progress than during May. The preparation of estimates and contract drawings for Poe Valley, Griffith and Nuss laterals was nearly completed. Surveys were made for several minor drains in the first unit. The elevations of the water surface in Clear Lake and in Tule Lake slowly receded during the month. On two occasions water was turned from Clear Lake into Lost River for irrigation of lands in the upper Langell Valley, pending the adjudication of water rights in the locality.

South Dakota, Belle Fourche Project (89 *per cent completed).*—Labor and weather conditions were favorable for construction work during the month, but on account of the extreme dryness the weather was unfavorable for crops. At Belle Fourche dam 500 square yards of block paving were placed during the month, the entire paving being completed on June 8. Three hundred and seventy-five linear feet of parapet wall were built and 1,300 cubic yards of gravel placed on the top of the dam. All of the main construction work on the dam was completed on June 15, the balance of the month being utilized in finishing ragged ends and cleaning up. The construction of the North canal, schedules 1 to 8, by contract was continued with good progress, and approximately 10,000 cubic yards of material were excavated by the contractors for the townsite lateral. Excellent progress was made by force account on North Canal structures and lateral excavation. About 12,000 acre-feet of water were delivered for irrigation, all of the available water in the reservoir being utilized.

Utah, Strawberry Valley Project (47 *per cent completed).*—With the exception of considerable rain in the vicinity of Strawberry dam, weather conditions were favorable for construction work. At Strawberry tunnel 273 linear feet were excavated during the month, progress being impeded by the water encountered in the heading. The average flow of water from the tunnel continued during the month at between 6

and 7 second-feet. The material encountered was mainly shale, which required careful timbering. Tunnel lining to the extent of 1,333 linear feet of sides and arch and 1,292 linear feet of bottom was placed during the month. The tunnel is 44 per cent completed. A construction camp was established at the site of the Strawberry dam, six miles of wagon road were completed, a number of the camp buildings erected, the dam site cleared, and work was commenced on the portals of the sluicing tunnel. Good progress was made on the construction of the transmission line from the west portal of Strawberry tunnel to the site of the dam. On the power canal considerable betterment work was done in the way of covering the section where rock slides occurred and taking down the loose rock from the slope of the rock cut at the diversion dam. A force of 300 men and 60 teams was employed on the project.

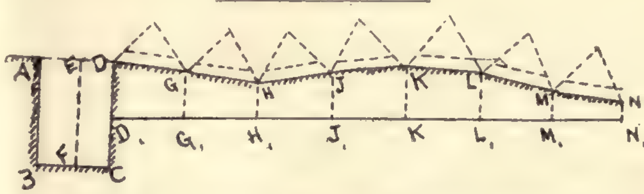
Washington, Okanogan Project (completed).—The usual operation and maintenance work was continued throughout the month. Water was delivered for the irrigation of about 5,000 acres of land. Water service was maintained practically without interruption, except for five days, from the 12th to the 16th, inclusive, when it was necessary to shut off the water on account of a very bad washout in the upper main lateral. The weather was very warm and but little rain fell, thus taxing the capacity of the system to supply the demands for water. Increase in stored water in the Conconully and Salmon Lake reservoirs amounted to 1,500 acre-feet for the month, making a total at the end of the month of 6,000 acre-feet available for use.

Washington, Yakima Project (storage unit 19 per cent completed; Sunnyside unit 66 per cent completed; Tieton unit 91 per cent completed).—Storage unit: The Lidgerwood-Crawford excavator made fair progress in the lake outlet channel, having excavated the trench from station 18+75 to station 22+00 during the month. On account of the depth of the cut, from three to five feet of the material in the bottom was not removed with the excavator, but was loaded on cars by hand and hauled by a donkey engine on an inclined track and dumped on the completed portion of the conduit for backfilling. The concrete was finished to station 15+60. The moving of the concrete mixing plant to station 20+50, from which point it will supply concrete until the completion of this conduit, was commenced. On June 19 the operation of an orange-peel excavator, mounted on a raft, was commenced in dredging the lake outlet channel. Only one scow was used, and it was hauled to deep water by a gasoline launch and dumped. A second scow was about ready for launching at the end of the month. Good progress was made in excavating the main cut-off trench with teams, but the work had to be abandoned temporarily on account of the high water in the lake. On June 12 excavation with a steam shovel was commenced on the trench for the outlet conduit through the dam, and good progress was made. On June 14 the river was turned through the temporary cut-off channel, which terminates in a 17-foot timber drop. The use of this cut-off channel leaves the river bed dry at the crossings near station 22 and station 27 of the outlet trench. The construction camp was practically completed, including a new water supply, roads and bridges. On June 21 excavation was started at the spillway with such teams as could be spared from the more important work. The Kachess storage works are 22 per cent completed. Weather and labor conditions were excellent.

Sunnyside Unit.—The enlargement of the main canal with the Bucyrus dredge and the Lidgerwood excavator was continued with good progress. All force account and contract work under the Prosser and Snipes Mountain divisions was completed. A number of measuring boxes and checks were constructed on the general distribution system. A pipe plant for the manufacture of 30½-inch pipe was established at Mabton, and good progress was made in the manufacture of collar segments. Water deliveries throughout the project were light, but satisfactory.

Tieton Unit.—The excavation of the main laterals on the Wide Hollow Branch was practically completed and the sub-laterals were about one-half finished. Work has continued on the various smaller structures in connection with the sub-lateral distribution system, and several metal main lateral flumes were erected. Plain and reinforced concrete pipe of small diameter was manufactured and laid in trenches. Hot weather on the first of the month and again on the thirteenth resulted in a heavy run-off in the Bumping river, causing the reservoir to fill rapidly and bringing the water surface within three feet of the spillway crest. Logs were held by a boom, hauled out of the water by a donkey and piled and burned. On that portion of the unit now under irrigation there was a brisk demand for water.

Wyoming, Shoshone Project (48 per cent completed).—Weather conditions were favorable throughout the month for field work, construction, and growth of crops. The fencing of the reservoir was continued, and the building of concrete structures on lateral A and Frannie canal, weirs at lateral turnouts on Garland canal, footbridges for gauging stations, and miscellaneous structures was carried on by force account. A board of engineers, with W. H. Sanders, consulting engineer, as chairman, investigated seepage conditions and recommended the construction of trunk line drains. In Shoshone reservoir water reached elevation 5,325, 260,000 acre-feet was in storage, and the flow from the reservoir averaged 2,350 second-feet. In Garland canal the maximum flow of water was 268 second-feet, supplying 265 farm units. The operation and maintenance force put in some additional paving below drops on Garland canal and repaired small structures. Most of the alfalfa on the project was cut, the better stands yielding approximately two tons per acre. Other crops were in good condition. Ralston unit was opened to entry June 23, and about thirty homeseekers visited the project, nine of whom filed on 470 acres of land. Surveys were continued for the location of a road extending between the forks of the Shoshone river and for the north side high line and Willwood canals.



HOW TO USE THE LEVELING FRAME.

In the July issue of THE IRRIGATION AGE there was described a leveling tool to be used for running levels or grade lines for ditches or other purposes. How to use the tool will be described in this article, reference being had to the accompanying drawing, which represents a profile along the line where the ditch, tile or pipe is supposed to run. Let A B C D be the principal drainage outlet; set the leveling frame over this ditch and measure the distance E F, which gives the lowest point to drain; let this distance E F equal 6 feet for example; then the point D is 6 feet higher than F; next place the leveling frame from D to G and observe the reading on the cross bar intersected by the plumb bob; let this show 3 inches lower than D; then point G has an elevation of 5.75 feet above F; next place the frame from G to H and take the reading of the plumb bob line, which we will assume shows 6 inches lower than G; then the elevation of point H is $5.75 - .50 = 5.25$ feet. Continue in this way along the proposed line; thus at the next point J suppose the reading shows 8 inches higher than H, then the elevation of J is $5.25 + .67 = 5.92$ feet; let K be 5 inches higher than J, then the elevation of K equals $5.92 + .42 = 6.34$ feet; at L let the point be 2 inches lower than K, then the elevation of L equals $6.34 - .17 = 6.17$; at M let the reading show 10 inches lower than L, then the elevation of M equals $6.17 - .83 = 5.34$; let point N be 3 inches lower than M, then the elevation of point N is equal to $5.34 - .25 = 5.09$ feet. Now suppose the drain is to be laid from point N we know that N is 5.09 feet higher than the bottom of the main ditch. If the base of the frame is just 10 feet, then the distance from N to D is 70 feet. As the fall in the ditch would not need to be more than 12 inches in this distance and the depth of the ditch at N won't need to be any deeper than 12 inches, the bottom of the ditch at N will be 4.09 feet higher than bottom of the drainage ditch F; also given the fall from N to D equals 1 foot; the bottom of the ditch D N, at point D, will be 3.09 feet higher than F. Thus the two end points of the ditch have been established. But this is not all; we can also figure out how deep the ditch will be at any of the intermediate points G, H, J, K, L and M. Point G is .25 feet lower than D and G is 1/7 of a foot equals .14 feet higher than D; hence the depth of ditch at G G, is equal to 2.91—

.39 = 2.52 feet. Proceeding in this manner the depth of the ditch or trench at any one of these points can be figured out and when excavated the grade line of the same will be found uniform.

It is to be understood, however, that for long distances the leveling frame should be superseded by a leveling instrument equipped with telescope and level, the readings being taken upon a leveling rod, which operation takes much less time and is perhaps more accurate, but it requires some knowledge to adjust the instrument and make the necessary computations.

ARIZONA'S IRRIGATION STATISTICS.

Acting Census Director Falkner has issued the first official statement from the Census Bureau relative to the statistics of irrigation in the territory of Arizona.

It is based on a preliminary comparative summary submitted by Dr. Le Grand Powers, chief statistician of the division of agriculture in the Bureau of the Census, under whose supervision it was prepared by R. P. Teele, special agent in charge of irrigation. This summary shows for both 1909 and 1899 the number of farms irrigated, the acreage irrigated, the acreage which existing enterprises are capable of supplying, the acreage included in existing projects, the number of independent enterprises, the length of main ditches, the total cost of irrigation systems, the average cost per acre irrigated, and the average annual cost of maintenance and operation. It shows also, for the year 1909, length of lateral ditches, number of reservoirs, capacity of reservoirs, number of flowing wells, number of wells pumped for irrigation, number of pumping plants, engine capacity of pumping plants, and acreage irrigated with pumped water. The acreage irrigated is classified by the type of enterprise supplying water and by the source of water supply.

The act of Congress of February 25, 1910, under which the census of irrigation is being taken, provides for collecting full information concerning the location, character, and cost of irrigation enterprises; whether such enterprises are conducted under national, state, or private control; the acreage of land irrigated; the prices at which land with water rights can be obtained, and the quantity of water used for irrigation.

It should be noted that the figures are subject to revision after more complete tabulation, but it is not expected that there will be any material modification of the totals or percentages reported. It is explained also that the census reports for 1899 do not show data concerning irrigation on Indian reservations in Arizona. For this reason comparisons between the 1909 and 1899 figures and corresponding percentages of increase and decrease have been made with the elimination of the totals for Indian reservations from the figures for 1909.

The total number of farms irrigated in 1909 was 4,509. Exclusive of Indian reservations, the total was 3,847, against 2,981 in 1899, an increase of 866, or 29.1 per cent.

The total acreage irrigated in 1909 was 320,051 acres, or, excluding Indian reservations, 300,665, against 185,396 in 1899, an increase of 115,269 acres, or 62.2 per cent. During the same period the improved land in farms outside of Indian reservations increased but 42.4 per cent, showing that a considerably larger part of the improved area was irrigated in 1909. The per cent of the improved area irrigated, outside of Indian reservations, increased from 81.4 in 1899 to 92.7 in 1909.

The total acreage which all enterprises were capable of supplying with water in 1910 amounted to 387,655 acres, an excess of 67,604 acres over the area irrigated in 1909. The total acreage reported in projects in 1910 was 944,090 acres, an excess of 624,039 acres over the area irrigated in 1909. This indicates in a general way the area which will be available for settlement within the next few years.

The number of independent enterprises was 1,269 in 1909. Excluding Indian reservations, the total was 1,218, against 519 in 1899, an increase of 699, or 134.7 per cent.

The total length of main ditches outside of reservations was 1,608 miles in 1909 and 1,492 in 1899, an increase of 116 miles, or 7.8 per cent. In 1909 there were 402 reservoirs, having a capacity of 1,348,358 acre-feet. Fifty-one Indian enterprises were reported in 1909.

The total cost of irrigation systems to July 1, 1910, was reported as $17,651,148. Eliminating reservation systems, the cost was $17,183,487, as against $4,408,158 in 1899, an increase of $12,775,329, or 289.8 per cent. The average cost of irrigation systems per acre irrigated in 1910 was $45.53, as compared with a cost of $23.90 in 1899, an increase of $21.63, or 90.5 per cent.

The average annual cost per acre for maintenance and operation in 1909 was $0.91, and $0.82 in 1899.

The acreage irrigated in 1909 has been classified according to the state and Federal laws under which the works were built or are operated, as follows: United States Reclamation Service (act of Congress, June 17, 1902), 138,364 acres, or 43.2 per cent of total; United States Indian Service (various acts of Congress), 19,386 acres, or 6.1 per cent; co-operative enterprises, 101,025 acres, or 31.6 per cent; enterprises supplying water for hire, 80 acres, or less than 0.1 per cent; and private and partnership enterprises, 61,196 acres, or 19.1 per cent. There are no Carey Act or irrigation district enterprises in the territory. Of the 138,364 acres reported as irrigated by the United States Reclamation Service, 134,364 acres are reported as having been irrigated by works built by others and taken over by the United States Reclamation Service. Works built by the United States Reclamation Service are to be turned over to the water users for operation and maintenance. Including these, 93.9 per cent of the acreage irrigated in 1909 was supplied by works controlled by the water users.

Streams supplied 307,778 acres, or 96.1 per cent of the total acreage irrigated in 1909; lakes, supplied 570 acres, or 0.2 per cent; wells supplied 7,585 acres, or 2.4 per cent; springs supplied 3,631 acres, or 1.1 per cent; and reservoirs supplied 487 acres, or about 0.2 per cent.

STATISTICAL RECORD OF THE UNITED STATES.

This annual publication originating with the Bureau of Statistics thirty-three years ago, then a small volume of 150 octavo pages, has grown with the growth of the country and the demands of the public for additional information, to 750 pages in this, the thirty-third number just issued. Purely statistical, and thus appealing only to those desiring definite information in concrete form, it presents many interesting pictures of conditions past and present in the United States.

For instance, the 100 pages devoted to the general subject of area, natural resources, and population, show the date of admission of each state and territory and their respective areas, the land area unappropriated and unreserved, amounting in 1910 to 712 million acres, and forming 41 per cent of the total land area of the country; swamps and overflow lands, 75 million acres; developed waterpowers, 5⅓ million horse-power; estimated coal supply of states and territories; estimated iron ore supply; the number of farms irrigated, 167,000 in 1907, and number of acres 11 million; the various irrigation projects commenced and the respective area to be reclaimed; population from 1790 by decennial years to the present time, and population of states and principal cities at each census; share which persons of foreign birth form of the population at various dates; marriage and divorce statistics; school population, enrollment, and attendance of pupils, universities, colleges and technical schools, with students and instructors; and temperature and rainfall for various sections of the country.

The fifty pages devoted to agriculture, forestry and fisheries show the number and acreage of farms by decennial periods extending back to 1880, value of farm property by states and territories amounting to over 20 billion dollars in 1900, the latest year for which complete statistics are available; the production of principal cereal crops, and of other farm products, including fruits, butter, wool and chickens; the wealth produced on farms for a term of years, showing a growth from 5 billion dollars in 1900 to practically 9 billion in 1910; and numerous other facts relating to the wonderful development of the agriculture of the country for a long term of years.

The 50 pages devoted to manufacturing and mining industries show the summary of manufactures by principal industries in census years from 1880 to 1905, the gross value of manufactures having grown from 5⅓ billion in 1880 to 15 billion in 1905; the production of iron ore, pig iron, steel, tin plates, coal, gold and silver; building operations in principal cities; and numerous other facts regarding the development of the manufacturing industry of the United States.

The 25 pages devoted to occupations, labor, and wages show the share of the population engaged in gainful occupations, including separate tables specifying number of each sex employed, and data as to strikes, lockouts, wages and hours of labor.

The 40 pages devoted to internal communication and transportation include data on the postal service, telegraph statistics, miles of railways operated, length of track, number of persons and tons of freight carried, showing a growth of railways operated in the United States from 30,500 miles in 1860 to 53,000 in 1870, 93,000 in 1880, 167,000 in 1890, 199,000 in 1900, and 250,000 in 1910. Data regarding express companies, transportation upon the lakes and principal rivers of the country, freight rates from principal interior points to the coast, and to European ports are also shown.

The 170 pages devoted to foreign commerce show values of imports and exports and trade with various countries for a long term of years, the imports having grown from 668 million dollars in 1880 to 789 million in 1890, 850 million in 1900, and 1,557 million in 1910; while the exports show a growth from 835 million dollars in 1880 to 858 million in 1890, 1,394 million in 1900, and to 1,745 million in 1910. The share which crude materials for use in manufacturing formed in the total imports in 1890 was 21.6 per cent; in 1900, 32.5 per cent, and in 1910, 36.4 per cent. Manufactures ready for consumption formed 29.2 per cent of total imports in 1890, 23.9 per cent in 1900, and 23.6 per cent in 1910. Manufactures exported in condition ready for consumption formed in 1890 15.7 per cent of the total domestic exports; in 1900, 24.2 per cent, and in 1910 29.2 per cent; while manufactures for further use in manufacturing formed in 1890 5.5 per cent; in 1900 11.2 per cent, and in 1910 15.7 per cent; foodstuffs in the meantime showing a material decline.

SOUTH DAKOTA'S IRRIGATION STATISTICS.

Census Director Durand has issued the first official statement from the Census Bureau relative to the statistics of irrigation in the state of South Dakota.

It is based on a preliminary comparative summary submitted by Dr. Le Grand Powers, chief statistician of the division of agriculture in the Bureau of the Census, under whose supervision it was prepared by R. P. Teele, special agent in charge of irrigation. This summary shows for both 1909 and 1899 the number of farms irrigated, the acreage irrigated, the number of independent enterprises, the length of main ditches, the total cost of irrigation systems, the average cost per acre irrigated, and the average annual cost of maintenance and operation. It shows also, for the year 1909, the acreage which existing enterprises are capable of supplying, the acreage included in existing projects, length of lateral ditches, number of reservoirs, capacity of reservoirs, number of flowing wells, number of wells pumped for irrigation, number of pumping plants, engine capacity of pumping plants, and acreage irrigated with pumped water. The acreage irrigated is classified by the type of enterprise supplying water and by the source of water supply.

The act of Congress of February 25, 1910, under which the census of irrigation is being taken, provides for collecting full information concerning the location, character and cost of irrigation enterprises; whether such enterprises are conducted under national, state, or private control; the acreage of land irrigated; the prices at which land with water rights can be obtained; and the quantity of water used for irrigation.

It should be noted that the figures are subject to revision after more complete tabulation; but it is not expected that there will be any material modification of the totals or percentages reported.

The total number of farms irrigated in 1909 was 500, against 606 in 1899, a decrease of 106, or 17.5 per cent. Within the same period the number of farms in the state increased 47.6 per cent.

* * *

Saratoga, Wyoming.

SARATOGA, WYOMING, AND VICINITY.

We are presenting in this issue two half-tones showing Saratoga, Wyoming, and an oat field in the Saratoga Valley, Wyoming. This is a particularly fine section of that state and attention has been called to it in former articles in this journal.

We intend, sometime during the coming winter months, to publish further information about this delightful section and the opportunities for homeseekers in the North Platte Valley.

Plans for a dam across the Nueces river, which will irrigate 22,000 acres of land, have been drawn by E. C. Sturgis of Denison, L. C. Cole of Ft. Worth and J. R. Black of Cotulla, Texas. It is estimated that the reservoir to be created will cover 1,000 acres. This body of land consists of 70,000 acres and is to be put under cultivation.

The National Irrigation Congress

by Arthur Hooker

Secretary National Irrigation Congress

The nineteenth annual meeting of the National Irrigation Congress will be held in Chicago from the fifth to the ninth of this coming December. In many ways this will be an eventful meeting of this great agricultural and commercial development agency. This will be the second meeting in Chicago, the first meeting having been held in that city in 1900. At that time Elwood Mead, then of Cheyenne, Wyoming, was president. Mr. Mead is now chairman of the State Rivers and Water Supply Commission of Victoria, Australia. George H. Maxwell, of Chicago, was chairman of the executive committee at the first Chicago meeting and H. B. Maxson, of Reno, Nevada, was secretary.

This year is also of special interest to the Irrigation Congress, as it marks the twentieth anniversary of its organization. The first Irrigation Congress met at Salt Lake City, September 15, 1891, remaining in session three days. The increasing interest in irrigation at that time has led to the holding of a state irrigation convention at Lincoln, Nebraska, in February of that year. Governor Arthur L. Thomas of Utah took the initiative in inviting the governors of the western states to appoint delegates to the first Irrigation Congress. Over four hundred and fifty delegates came the first day and this number was increased by other arrivals on the following days.

Colonel John T. Donnellon was temporary chairman of this first meeting. C. C. Wright, of California, was president and Wm. E. Smythe, now of San Diego, California, popularly known as the "Father of the National Irrigation Congress," was secretary. Senator Newlands, of Nevada, took a prominent part in this first meeting and there were addresses by George Q. Cannon, Wilford Woodruff and other leaders in this movement in those early days. Since this early meeting the Congress has been entertained by various cities from Chicago to the Pacific and from near the Canadian line to the Mexican border, leaving in every meeting place definite results and contributing beyond estimation to the wealth, happiness and prosperity of the people of the arid and semi-arid states. The appended table shows the meeting places and officers of the Congress since its organization.

The men who have been behind the National Irrigation Congress and whose efforts have given it the commanding position which it now occupies are of that stamp who believe the way to do things is to do them. It follows that the history of the Congress is a record of achievements. And what a wonderful record it is. It is doubtful if there are many persons today who fully realize the importance of the work started and fostered by the National Irrigation Congress.

The Reclamation Act, the Carey Act and other national and state legislation has accomplished that which was only dreamed of a few short years ago. But it has done more than that which the enabling clause contemplated. It has placed the seal of government approval upon reclamation work and thereby given a standing and created a confidence in it, which otherwise never would have been. And this has made it possible to enlist private capital and enterprise to an extent hardly realized, making the irrigation, reclamation and home-building movement today one of the most remarkable in the world's history.

The honor of entertaining the nineteenth meeting of the Congress was won for Chicago by her delegates and supporters after a spirited contest at the meeting at Pueblo, Colo., last September, in which Los Angeles came near taking the honors away from Chicago. Yielding to the Chicago spirit of "I Will," the friends of Los Angeles at that time signified their determination to secure the 1912 meeting of the Congress and are coming to the December meeting with their determination strengthened that Los Angeles shall entertain the twentieth Congress. The Los Angeles delegations may not have everything their own way, as there are several cities anxious to secure the next Congress, and, with the great interest being shown in drainage reclamation, New Orleans is being mentioned as a strong candidate for the privilege of entertaining the 1912 meeting, it being urged that no other city could so effectively support a drainage reclamation campaign and unite the development forces of the West and South.

Following the meeting at Pueblo in September, 1910, the executive committee organized to carry on the work between meetings to the best advantage. The active representatives of the executive committee between sessions are the board of governors, consisting of: R. Insinger, of Spokane, chairman; B. A. Fowler, Phoenix, Arizona; Dr. W. J. McGee, Washington, D. C.; W. S. Hopewell, Albuquerque, N. M.; W. G. DeCelle, Chicago, and Arthur Hooker, Chicago.

Soon after the Pueblo meeting there was organized at Chicago a board of control of one hundred of Chicago's leading business men which, through its five large committees, is making extensive preparations for the reception and entertainment of the visitors and delegates. The chairmen of the committees are: Committee on foreign representation, Dr. W. A. Evans, former health commissioner of Chicago, chairman; committee on entertainment, John C. Shaffer, president Chicago Evening Post Co., chairman; committee on attendance and transportation, W. L. Park, vice-president Illinois Central Railroad, chairman; committee on care of delegates, Frank E. Scott, president Scott Transfer Co., chairman; committee on publicity, Edmund T. Perkins, president Edmund T. Perkins Engineering Co., chairman.

The general officers of the Congress are: President, B. A. Fowler, Phoenix, Arizona; vice-presidents, first, Fred W. Fleming, Kansas City, Mo.; second, L. Newman, Great Falls, Mont.; third, A. G. Watson, Pueblo, Colo.; fourth, John Fairweather, Fresno, Cal.; fifth, B. C. Buffum, Worland, Wyo.; foreign secretary, Dr. E. McQueen Gray, Albuquerque, N. M.; secretary, Arthur Hooker, Chicago.

It has been said: "The National Irrigation Congress stands for no party, no interest, no clique and no section of the country. It should be the forum where all parties could be heard, all individuals have the same right, no section monopolizing or controlling the action of the Congress, which stands for the whole country and especially for the irrigation needs of the great arid West. In this organization we know no North, no South, no East, no West. We should not be influenced by the political platforms or policies as against the truest and best interests of the nation as a whole.

"Full discussion of every question should be allowed, not only allowed but invited. There may be sharp differences of opinion and judgment, but they should be differences of gentlemen where patience, forbearance and universal courtesy are not only the rule, but absolutely required, and demanded of each speaker. Only by such a policy as this will the Irrigation Congress ever reach its high ideals, ever achieve the results for which it is aiming; while on the other hand, to pursue an opposite course, is to invite deterioration, even suicide and death. This should be the announced policy of the Congress. We have nothing to cover up or conceal and on its platform the slogan must be, 'Equal rights to all and special privileges to none.' "

There are in this country close to 40,000,000 acres of arid land capable of irrigation and for which there is water available. Of the swamp and overflow lands capable of drainage there are 80,000,000 acres. These figures are so large that their meaning and the possibilities they present are not fully comprehended. They emphasize, however, the importance of the utilization of our water and the reclamation of our land. They offer one solution for the great problem of the increased cost of living.

To quote the late Governor John A. Johnson, there are in the West "Homes for the homeless; food for the hungry; work for the unemployed; land for the landless; gold for the penniless; freedom for the enslaved; adventure for the restless; dangers for the brave; an unknown world to conquer, and room for all." The National Irrigation Congress plans to make known these opportunities to those who are looking for them and eager to take advantage of them.

MEETING PLACES AND LIST OF OFFICERS OF THE NATIONAL IRRIGATION CONGRESSES—1891-1911.

First Congress, 1891—Salt Lake City, Utah. C. C. Wright, California, president; Gov. Arthur L. Thomas, Utah, chairman executive committee; Wm. E. Smythe, San Diego, Cal., secretary.

Second Congress, 1893—Los Angeles, Cal. J. S. Emery, Lawrence, Kan., president; Wm. E. Smythe, San Diego, Cal., chairman executive committee; Fred L. Alles, Los Angeles, Cal., secretary.

Third Congress, 1894—Denver, Colo. Elwood Mead, Cheyenne, Wyo., president; Wm. E. Smythe, San Diego, Cal., chairman executive committee; Fred L. Alles, Los Angeles, Cal., secretary.

Fourth Congress, 1895—Albuquerque, N. M. Geo. L. Cannon, Salt Lake City, Utah, president; F. R. Moses, Great Bend, Kan., chairman executive committee; Fred L. Alles, Los Angeles, Cal., secretary.

Fifth Congress, 1896—Phoenix, Ariz. C. B. Boothe, Los Angeles, Cal., president; E. R. Moses, Great Bend, Kan., chairman executive committee; Jas. H. McClintock, Phoenix, Ariz., secretary.

Twelfth Congress, 1904—El Paso, Texas. W. A. Clark, Butte, Mont., president; C. B. Boothe, Los Angeles, Cal., chairman executive committee; A. W. Gifford, El Paso, Texas, secretary.

Thirteenth Congress, 1905—Portland, Ore. Gov. Geo. C. Pardee, Oakland, Cal., president; C. B. Boothe, Los Angeles, Cal., chairman executive committee; Tom Richardson, Portland, Ore., secretary.

Fourteenth Congress, 1906—Boise, Idaho. Gov. Geo. C. Pardee, Oakland, Cal., president; Montie B. Gwinn, Boise, Idaho, chairman executive committee; H. B. Maxson, Reno, Nev., secretary.

Fifteenth Congress, 1907—Sacramento, Cal. Gov. Geo. Chamberlain, Portland, Ore., president; W. A. Beard, Sacramento, Cal., chairman executive committee; D. H. Anderson, Chicago, Ill., secretary.

Sixteenth Congress, 1908—Albuquerque, N. M. F. C. Goudy, Denver, Colo., president; F. C. Goudy, Denver, Colo., chairman executive committee; B. A. Fowler, Phoenix, Ariz., secretary.

Seventeenth Congress, 1909—Spokane, Wash. Geo. E. Barstow, Texas, president; W. A. Beard, Sacramento, Cal., chairman board of governors; B. A. Fowler, Phoenix, Ariz., secretary.

OFFICERS OF THE NINETEENTH NATIONAL IRRIGATION CONGRESS.

ARTHUR HOOKER, Secretary, Chicago, Ill. B. A. FOWLER, President, Phoenix, Ariz. FRED W. FLEMING, First Vice-President, Kansas City, Mo.
A. G. WATSON, Third Vice-President, Pueblo, Colo. R. INSINGER, Chairman Board of Governors, Spokane, Wash. L. NEWMAN, Second Vice-President, Great Falls, Mont.

Sixth Congress, 1897—Lincoln, Neb. Jos. M. Carey, Cheyenne, Wyo., president; E. R. Moses, Great Bend, Kan., chairman executive committee; F. J. Mills, Boise, Idaho, secretary. No proceedings printed.

Seventh Congress, 1898—Cheyenne, Wyo. Jos. M. Carey, Cheyenne, Wyo., president; Jos. M. Carey, Cheyenne, Wyo., chairman executive committee; O. E. McCutcheon, Saginaw, Mich., secretary.

Eighth Congress, 1899—Missoula, Mont. Dr. S. B. Young, Salt Lake City, Utah, president; C. B. Boothe, Los Angeles, Cal., chairman executive committee; H. B. Maxson, Reno, Nev., secretary.

Ninth Congress, 1900—Chicago, Ill. Elwood Mead, Cheyenne, Wyo., president; Geo. H. Maxwell, Chicago, Ill., chairman executive committee; H. B. Maxson, Reno, Nev., secretary.

1901—Buffalo and Colorado Springs selected. No Congress held at either place.

Tenth Congress, 1902—Colorado Springs, Colo. Thos. F. Walsh, Washington, D. C., president; C. E. Wantland, Denver, Colo., chairman executive committee; H. B. Maxson, Reno, Nev., secretary.

Eleventh Congress, 1903—Ogden, Utah. W. A. Clark, Butte, Mont., president; Fred J. Kiesel, Ogden, Utah, chairman executive committee; H. B. Maxson, Reno, Nev., secretary.

Eighteenth Congress, 1910—Pueblo, Colo. B. A. Fowler, Phoenix, Ariz., president; R. Insinger, Spokane, Wash., chairman board of governors; Arthur Hooker, Spokane, Wash., secretary.

Place and Officers Selected for the Nineteenth Congress, 1911—Chicago, Ill. B. A. Fowler, Phoenix, Ariz., president; R. Insinger, Spokane, Wash., chairman board of governors; Arthur Hooker, Spokane, Wash., secretary. Congress address, Chicago, Ill.

SOMETHING NEW IN IRRIGATION FLUMES.

The Corrugated Metal Company, of Emporia, Kansas, is advertising something new in irrigation flumes.

Their flume is made of corrugated iron in 12, 14 or 16 gauge, and is a practical, moderate priced flume. This flume is made in sections of any length up to 22 feet and formed in such a way that the sections can be easily placed and bolted together. No solder is necessary in the construction of this flume and it positively does not leak.

One of these flumes is in operation near Syracuse, Kansas, having replaced a wooden flume. They are made in all sizes and will no doubt in time replace the old wooden flume.

THE PRIMER OF HYDRAULICS*

By FREDERICK A. SMITH, C. E.

Article IX. General Hydraulic Principles.

1. *The Cause of Flow in Fluids and Definitions.*

The flow of liquids is generally produced by the force of gravity. In Fig. 72 let the vessel *AGKL* be filled with water to line *AG* and let *EJ* be a pipe of considerable length, having tubes *C, D* and *B* in connection therewith, and tube *EJ* is closed at *J.* Then the water is at rest and stands level in the reservoir and in the tubes. If now the pipe is opened at *J* the water rushes out at *J* with a certain velocity; the water drops in the tubes *C, D* and *B* to points *C, D, B,* and if a line is drawn through these three points to

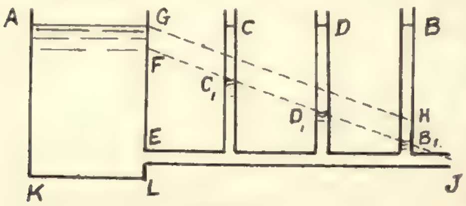


Fig. 72.

the vessel *AG* it strikes at point *F,* a certain distance lower than the height of the water *GL.* The height *GF* is called the *velocity head* and is that part of the total potential energy of the height *GE* which is used to produce the velocity in the pipe; the remainder *FE* is called the *pressure head,* which is used in overcoming the friction throughout the pipe *EJ;* the height of the water in the tubes *C, D* and *B* show the decrease in the pressure heads successively; if the line *GH* is drawn parallel to *FB,* it will be seen that the velocity head *FG* is uniform throughout the flow length.

If the velocity is measured carefully at *J* it is found that the height *GF* is in excess of the height of fall required to produce such velocity. If v is the velocity at *J* then in the the equation: $v^2 = 2gh$

h can be found by dividing both sides by $2g$: $h = v^2/2g$; then suppose the velocity $v = 4$ ft., then $h = 16 \div 64 = .25$ ft. or 3 inches. The distance *GF* would be then 3 inches if there was no further loss in energy; there occurs, however, an additional loss at point *E,* which loss is termed the *entry-head,* and which depends on the form of entry and which may vary from one-half to one-tenth of the velocity head.

The line *FB* is called the *hydraulic grade line.*

2. *Other Hydraulic Terms and Definitions.*

When water flows through a channel conduit or pipe the

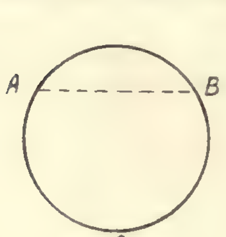


Fig. 73.

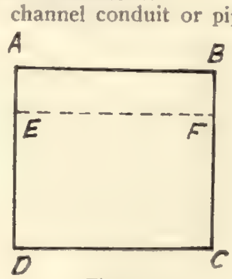


Fig. 74.

velocity of the flow depends on several factors—namely, the form of channels, the depth of flow, the roughness of the sides of the channel and the grade of the flow line, commonly called the sine of the slope. Thus if the cross-section of a channel is circular, as in Fig. 73, and if the water stands up to the line *AB,* then the wetted surface along the circumference from *A* to *B* via *C* is called the *wetted perimeter;* the *flow area* is the area of the cross-section of the flowing water and if the flow area is divided by the wetted perimeter the quotient gives the *hydraulic radius,* which will be termed r. Thus, if a pipe of the diameter d is flowing full the wetted perimeter is πd; the area will be $\pi d^2/4$; hence the hydraulic radius $r = \pi d^2/4 \div \pi d = d/4$.

This proves that the hydraulic radius for all cylindrical conduits flowing either full or half full equals one-fourth of the diameter.

In Fig. 74 is shown a rectangular channel in cross-section *ABCD;* if the height of the flow reaches to *EF,* then the hydraulic radius will be found as follows: flow area equals $DC \times ED$ and wetted perimeter equals $ED + DC + FC$, hence:

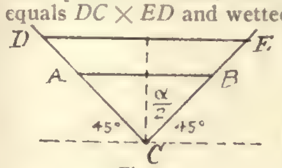


Fig. 76.

$r = DC \times ED \div (ED + DC + FC)$;

Should the box flow full, however, so that the water touches the upper surface *AB,* then the wetted perimeter increases greatly causing a decided drop in the hydraulic radius.

For instance, let the box be 2 ft. wide and 3 ft. high—then $r = 3 \times 2 \div (3 + 2 + 3 + 2) = 6 \div 10 = .6$.

On the other hand, let the water surface *EF* be 2 ft. high; then:

$r = 2 \times 2 \div (2 + 2 + 2) = 4 : 6 = .67$.

In Fig. 75 is shown a cross-section of a triangular channel. If the water stands up to line *DE* then the hydraulic radius r is equal to the area of the triangle *DEC* divided by the wetted perimeter $DC + EC$. Should the box, however, run full the wetted perimeter is increased by the length of the cover and results in a greatly decreased hydraulic radius.

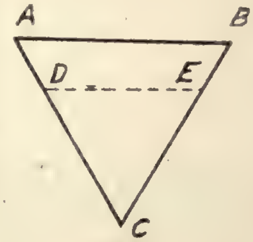


Fig. 75.

3. *General Principles.*

The well-known formula of Kutter:

$v = C\sqrt{rs}$

is at the present time without doubt the most generally used and gives correct results in practice if applied rightly. The various elements entering into its composition must, however, be correctly determined and intelligently handled. In the above equation v is the mean velocity of the liquid in feet per second, r is the actual hydraulic radius and s is the sine of slope. The coefficient C is a complex quantity and is derived by calculation from the following formula:

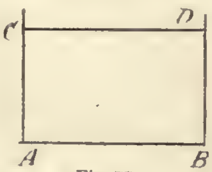


Fig. 77.

$$C = \frac{41.6 + \frac{1.811}{n} + \frac{.00281}{s}}{1 + \left(41.6 + \frac{.00281}{s}\right)\frac{n}{\sqrt{r}}}$$

In this formula the quantity n is called the coefficient of roughness, s is the sine of the slope and r the hydraulic radius as explained above.

The factor n, then, is really the most difficult quantity to determine, as its correct selection is very important. There is, however, sufficient experience to be drawn from, so that the degree of roughness or factor n can be selected with considerable precision.

In this book the coefficient C has been calculated for factors of roughness varying from .009 to .050, which embraces all imaginable practical channels. Since the variation of the factor C is slight for very considerable differences in slopes, the factor C has been determined only for six different slopes which covers the field fully as any intermediate slopes can be easily interpolated when necessary. This will later be shown by practical problems.

The tables have been computed for the square root of r instead of r, as this gives a considerable wider range of application, and the factor C is found with sufficient accuracy by interpolation between the values shown.

4. *Forms of Open Channels.*

The form of a channel is an important factor for the flow of water, and we will consider the characteristics of some of the most important ones. All other things considered equal, the velocity of flow grows as the hydraulic radius r grows, which is plainly seen from the fundamental formula:

$v = C\sqrt{rs}$

hence the larger r the better the flow conditions will be. To compare the relative efficiency of various forms we will take the triangular, rectangular, trapezoidal and circular sections which are in general use. Let Fig. 76 show the cross-section of a triangular channel, the sides of which incline 45° to the horizon and form an angle of 90° with each other. This kind of section is best adapted when a considerable velocity of flow is required with a small volume of fluid. To prove this it is easily seen that the factor r grows or falls in a constant ratio, no matter how high the water rises or how

low it goes; thus if the water stands up to line AB, the hydraulic radius r equals: area of triangle ABC divided by the wetted perimeter $AC + BC$; let $AC = a$, then area of triangle $= a^2 \div 2$; wetted perimeter $= 2a$, hence:

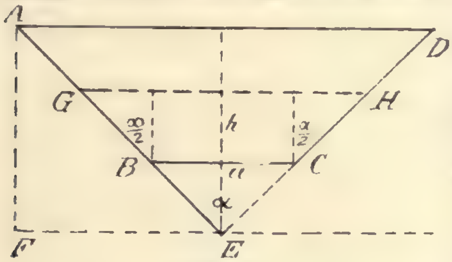


Fig. 78.

$r = a^2 \div 2 \div 2a$
$r = a^2 \div 4a$
$R = a \div 4$

If a now is doubled, r is doubled; if a is made half, then r is made $r/2$, the general form of r being $a/4$, a being length of one wetted side.

The angle ACB may have a different value x; then, if h is the depth of flow, the area of flow equals $h^2 \text{tg} \frac{x}{2}$, and the wetted perimeter $= \frac{2h}{\cos \frac{x}{2}}$, hence $r = h^2 \text{tg} \frac{x}{2} \div \frac{2h}{\cos \frac{x}{2}}$, which can be reduced to $.5h \text{ tg} \frac{x}{2} \cos \frac{x}{2} = .5h \sin \frac{x}{2}$, which is the general form for r in triangular channels.

Fig. 77 is a rectangular section. Let CD be the upper plane of flow, then area $ABCD \div (AC + AB + BD)$ would be r. It is seen that when $AC = AB$ the hydraulic radius $= AB \div 3$; for if $AB = a$, area $= a^2$, and wetted perimeter $= 3a$, hence $r = a^2 \div 3a = a \div 3$.

With the width of channel constant, the hydraulic radius varies with the height; as stated above, it is $a \div 3$, when the cross-section of flow is a square; r decreases with the height and equals zero when the height AC is zero; r increases as the height increases, and reaches its maximum when AC equals infinity, in which case $r = a \div 2$.

The trapezoidal form of channel is shown in Fig. 78. If the two sloping faces AB and CD are extended until they meet in E, the section may be considered triangular with the lower part BCE cut away.

A section of this form will be useful when the variation in volume of flow is not very large, and where the cutting might have to be carried to too great depths if the true triangular form were adopted.

Best conditions are obtained if angle $AED = 90°$ and angle $AEF = 45°$. This would make the slope 1 to 1, which might have to be modified for the various conditions under which the channel is to be constructed.

Assume angle $AEC = 90°$ and $BC = a$; let GH be flow line and $h =$ depth of flow; then area of flow: $(a + h)h$; the wetted perimeter $P = GB + BC + CH$; $GB = HC = \sqrt{2h^2} = h\sqrt{2}$; hence wetted perimeter $p = a + 2h\sqrt{2}$.

If we divide p into area we get $r =$

$r = h\,(a + h) \div (a + 2h\sqrt{2})$.

It is seen from this formula that r increases as h and a are increased; if a is made equal to zero the formula changes:

$R = h^2 \div 2h\sqrt{2} = h \div 2\sqrt{2}$.

This is the case of the triangular section expressed in terms of the depth of flow. When h and a are equal the formula of r appears thus:

$r = h(h + h) \div h + 2h(\sqrt{2}$

$r = 2h^2 \div h(1 + 2\sqrt{2})$, which may be simplified to:

$r = 2h \div 1 + 2\sqrt{2}$

$r = h \div 1.914 = .52h$.

This is equal to more than half of the height and is the best section for high velocity of this kind.

If the angle $AED = x$, then the flow area will equal $h(a + h \text{ tg} \frac{x}{2})$ and the wetted perimeter $= a + \frac{2h}{\cos \frac{x}{2}}$, hence

$$r = \frac{h\,(a + h \text{ tg} \frac{x}{2})}{a + \frac{2h}{\cos \frac{x}{2}}}$$

which is the general form for the trapezoidal channel.

A MOVE IN THE RIGHT DIRECTION.

If apple growing can be put on a sure and profitable basis in Iowa, the horticulture and soil experimentalists of the experiment station at Iowa State College have determined to find out how.

To this end, the director of the station, C. F. Curtiss, has leased an established orchard of twenty-three acres in Pottawattamie county, near Council Bluffs, for a period of ten years. Here Prof. S. A. Beach of the horticulture section and Prof. W. H. Stevenson of the soils section and their assistants will apply the best known methods of cultivation so that Iowa orchardists may be practically advised how to put their orchards on a paying basis. Laurenze Greene, station experimentalist, will have immediate charge of the project.

The orchard will be put into proper condition by pruning and otherwise as soon as possible. The ground will be divided into different plots and given different methods of cultivation. In the spring, an organized fight against frost will be made with the best oil-heater apparatus. In the spraying season the trees will be thoroughly treated for apple pests. In the fall the fruit will be harvested and marketed in a business-like way.

The study of the soils of the orchard and their response to different treatments promises to be one of the most valuable features of the experiment. Very few orchardists in Iowa realize the importance of maintaining the fertility of orchard soil. They rob it year after year without putting anything back into it and then wonder why apples are not successfully grown. For this experiment the orchard has been divided into six plots, running across the rows of trees, which include a dozen varieties, so that every plot contains all the varieties. Plot No. 1 is seeded to clover, which will be cut and allowed to remain on the ground as a mulch; every second year the lot will be plowed and reseeded to clover. Plot 2 will be thoroughly cultivated each year until midsummer and then seeded to some leguminous cover crop which will be allowed to grow and then be plowed under in the spring. Plot 3 will be given clean cultivation throughout the summer. The fourth plot is seeded to blue grass, which will be cut and allowed to remain on the ground as a mulch; this plot will not be plowed, however. The fifth and sixth plots will be treated as the first and second.

The effect of these methods on the humus, moisture and plant food content of the soil will be carefully determined, and also the effect on the trees in their growth and fruit bearing.

Books upon every phase of the experiment will be kept carefully so that as the experiment progresses it may be pretty definitely gathered from results whether scientific orcharding can be made to pay in Iowa as well as in other sections of the country. The records will show also what methods are most satisfactory. The orchard chosen for the experiment is a fairly representative orchard and what may be done with it may be done with most Iowa orchards.

Those in charge of the experiment have faith in Iowa's ability to produce apples successfully. They hope to prove their faith and show how orchards may be made to pay.

ASPINWALL MANUFACTURING COMPANY'S ANNUAL MEETING.

The annual meeting of the stockholders of the Aspinwall Manufacturing Company was held at the company's offices in Jackson, Michigan, Tuesday, August 8, election of board of directors being held. The directors in a subsequent meeting elected the following officers for the ensuing year: President, L. A. Aspinwall; vice-president and manager, C. G. Rowley; treasurer, G. N. Whitney; secretary, J. A. Parkinson, Jr. The company has enjoyed a successful year in all respects and prospects for 1912 are exceedingly bright.

Engineer J. W. Mavity of Lyndon, Kansas, has just returned from Texas, where he has been making surveys, plans and specifications for an irrigation project on the Pecos River, Pecos County, Texas.

CORRESPONDENCE

INFORMATION WANTED ABOUT FISH SCREENS.

The Irrigation Age, Chicago, Ill.

I received your notice of the 25th reference to my subscription. I will inclose $2.00 to apply on old and renewal for 1912. I would like to know of any device used to keep fish out of irrigating ditches and canals, and if it is compulsory for the ditch company to keep them out. The fish commissioner for this state claims we have to keep them out by having a ¼-inch mesh screen in the ditch or canal, and they have approved of a fish screen, and are recommending it to all ditch and canal owners; the cost is outrageous, $75.00; freight and installation will exceed $25.00, so we are up against a hundred-dollar deal that has never been tried out and the life of it is guesswork. If you know of any devices working in other districts that are satisfactory and reasonable, you would confer a favor to irrigationists by letting us know about it. Your paper is better than ever, and as irrigation is growing so fast in the western states, the more use there is for facts about this great work. Reliable information is what we want and are willing to pay for. There are about 50 irrigating ditches and canals in the Methow Valley. If they don't get The Irrigation Age let me know, and I will send you their addresses. Very respectfully yours, Wm. A. Sexsmith.

[Can some one of our readers give Mr. Sexsmith the desired information? It would seem that $100 is a high price to pay for fish screens.—Editor.]

ENCOURAGING REPORTS FROM MONTANA.

Logan, Montana. August 10, 1911.

Mr. D. H. Anderson,
Care The Irrigation Age,
Chicago, Illinois.

In answer to your inquiry as to the crop conditions in the state of Montana, we are very glad to give you the following information: Practically all of our small grain crops have been harvested, and so far the returns have been far beyond the expectation of the farmers. Many of our crops upon dry land are making as high as fifty bushels of hard wheat to the acre, and due to the shortage of wheat throughout the country, the price has gone higher than we figured it would go. We are now getting eighty-five cents per bushel f. o. b. cars along the railroad points in this county.

We have had all the rainfall that has been required, and the only exception to successful crops are due entirely to the poor farming and poor judgment of the farmer. In every instance where the farming has been properly carried on, the wheat makes fully forty to fifty bushels to the acre. Oats would easily make an average of seventy bushels, and the hay is beyond any one's belief, making from four to five tons to the acre, with the clover and alfalfa crops the largest we have known for years. Potatoes, while of course not fully grown, have all the indications of an exceptionally large crop, and should be very large in size.

The prices of land through this country range for the non-irrigated land, from $17.50 to $22.50 per acre, and it is fast being taken up at those prices. Irrigated lands are governed largely by the amount of improvements, and are priced from $40.00 to $75.00 per acre.

We have been in the cattle business for some twenty years, but due to the fact that the country is largely being converted into an agricultural district, we find that the running of cattle in large herds is not profitable, and so we have gone out of the cattle business, and are now offering our lands at the above prices.

Any of your friends that may wish to come to Logan and investigate our lands, we will be only too pleased to show them to them, and will guarantee every statement in this letter to be true, to the extent that if they are not, we will gladly pay the railway expense of any one who comes to investigate.

Our church, school and social relations are of the highest standard, while tuberculosis and other of the dreaded diseases are practically unknown in this country. Our altitude is 4,000 feet, and owing to the prevailing Chinook winds, the weather during the winter season as a rule is very pleasant.

We have the main line of the Northern Pacific through Logan, and the Milwaukee is only five miles distant. At the present time the Burlington is running over the Northern Pacific tracks, giving us three transcontinental railways, and located as we are at the headwaters of the Missouri river, which is formed by the confluence of the Gallatin, Madison and Jefferson rivers, makes it one of the most beautiful spots in the Northwest.

Thanking you very much for your inquiry, and hoping to see some of your friends in Logan, we are,

Yours very truly,
W. E. Crowley

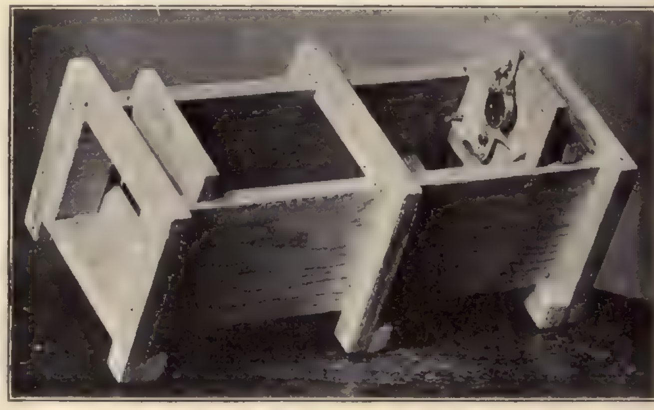
A NEW MEASURING BOX FOR WATER.

Bozeman, Mont., July 14, 1911.

The Irrigation Age, Chicago, Ill.

Seeing the interest you take in all things pertaining to the farmers' interest, thought you would be interested in the combination headgate and water measuring device which I am mailing you for your inspection and criticism.

We have gone to great expense and trouble to have this box calibrated by the Montana State Agricultural College and the card enclosed is the result. Now this card of course is for Montana miners' inches. Other states differ. We have, however, the correct calibration for any state. We have manufactured these headgates this season only, but the 700 farmers who have put them in are



all very much pleased with them, as they can see and understand for themselves whether they are getting the water they are entitled to or not, which with a weir or current meter is hard to understand.

This box has been adopted as the official device for measuring water at Big Timber for all of Sweet Grass county. It is approved by the judges of the court and commerce clubs and leading cities of this state. Its merits are: First, it is accurate in measurement; second, it is easily understood, a ten-year-old boy can measure water accurately with it; third, it does away with the extra expense of building a weir, which costs much more if built so as to accurately measure water; fourth, all farmers having the same device, enables a dissatisfied water user to know whether his neighbor is using or stealing his water or not; fifth, it is locked at the proper height for the maximum for the farmer and he can not raise it; sixth, the farmer controls the upper gate and can shut off the water and lock it off and no one can flood him.

I am sending you some data as to this which you may use if you see fit to use and return it to me when you get through. Ivy Park.

[The half-tone shown herewith gives a perspective view of this measuring box and the rating curve, which is

also shown and which enables the user to set the device so as to get his exact allowance of water. Professor R. D. Kneale of the Montana State College of Agriculture and Mechanical Arts certifies that the box will give results, being accurate to within 5 per cent, which is unusually reliable.—Directions for setting and using are also appended.—(Editor.)

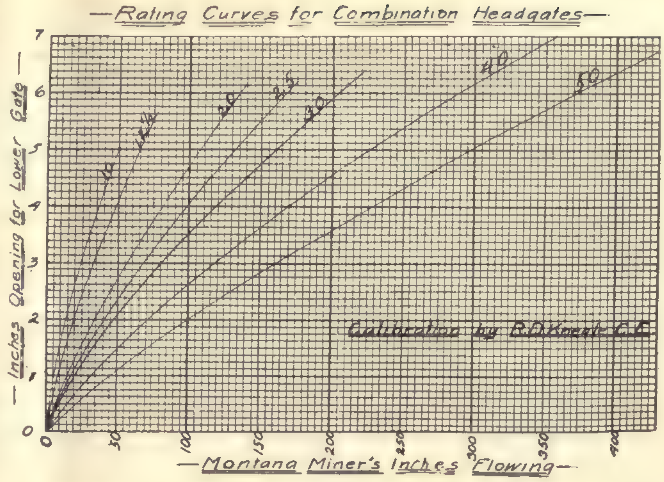
Directions for Setting.

1. Place the box so that the floor is level. This can be done by leveling with water, or by using a spirit level.
2. See that there is sufficient fall below the lower end so that the water passing through the box will not accumulate and back up against the box.

Directions for Using.

1. Select from the lower edge of the rating sheet the number of Montana miner's inches desired. Follow a straight line from this point up to the curve of the box in use. From the point thus found on the curve, follow a straight line to the left edge of the sheet. The number found on the left edge will be the inches of opening required. Open and fasten the lower gate at this opening.
2. Admit sufficient water at the upper gate to raise the water three inches above the upper edge of the lower opening.

Note.—If the wave motion gives trouble in deciding when the water is three inches above the lower opening, estimate the correct amount by vibrations, that is, see that the wave exposes as much surface below the three-inch line as it covers above that line.



SILOS FOR MISSOURI.

The Agricultural Experiment Station at Columbia, Mo., has just issued two new silo bulletins. They are: Circular No. 48, "The Plastered or Gurler Silo," and Circular No. 49, "The Reinforced Concrete Silo."

The Gurler silo is especially adapted to those sections of Missouri where there is still a supply of native lumber. It is cheap, fully as lasting as a wood silo, and preserves its contents as well as any more expensive structure. The reinforced concrete silo is built of solid concrete with iron rods or strands of wire running through the walls to prevent cracking. It is adapted to any section of the country where sand and gravel or crushed rock may be obtained and on account of its great durability it is probably the cheapest of all silos in the long run.

Anyone desiring information in regard to the details of building either the plastered or the solid concrete silo should write for these bulletins. They may be obtained free of charge by addressing F. B. Mumford, Director, Columbia, Missouri.

Subscribe for The Irrigation Age—only one dollar per annum and over 400 pages of reading matter pertaining to irrigation and reclamation.

Reclamation Notes

CALIFORNIA.

Within the next ten days actual construction work on the Oakdale and South Joaquin irrigation systems will be started and before the winter rains set in it is planned to have the big dam across the Stanislaus completed.

A gang of men are now at work on the irrigation canal that is to be run through Thornton and the Patten Land Company's ranch. Its completion means irrigation to thousands of acres of land that only need the water to make the "pocket section" one of the most fertile and productive spots in the state.

A new impetus has been given the Riverbank townsite and other lands by the commencement of irrigation work in the Oakdale district. It is expected to get water on the land for use next summer, and have it all placed there by March, 1913.

Announcement has been made of the launching of a big irrigation project for Butte and Yuba counties by which it is proposed to place 70,000 acres of the lands of these two counties under a ditch system. The water will be delivered at a point in the foothills just before the valley is encountered and will be carried north through Yuba into Butte County.

The siphon for the Butte County canal, by which water can be carried under the Cherokee canal, is finished. The siphon is 500 feet long, of reinforced concrete and has a carrying capacity of 250 cubic feet of water per second, or, in other words, it is large enough to drive an automobile through. The canal is used to furnish the people of Richvale with water for irrigation and it was necessary to pass under the Cherokee canal to reach them.

O. E. Hotle, a well-known realty and bond broker of Oakland, is launching a big irrigation project in Butte and Yuba counties, by which it is proposed to place 70,000 acres of the lands of these two counties under a ditch system. It is reported that the Fleishhacker interests are behind the project, although Mr. Hotle has authorized a statement to the effect that the Fleishhackers are not the owners.

People in the Dry Creek country are ascertaining the possibility of annexing a large part of that section to the Oakdale Irrigation District. Surveys are being run from near the Williams House to Warnerville.

Wonderful growth of the sugar beets in the irrigated districts of Glenn County indicate the greatest crop in years. The farmers have learned to get better results by scientific cultivation.

COLORADO.

Nine thousand acres of fertile land are to be watered from the Hevemeyer or Grand Valley irrigation district. Lumsden & Gordon of Grand Junction received the contract for this piece of work. The canal will be completed and water will be turned on the land by the first of next May.

The Standley dam, near Denver, the largest of its kind in the world, is completed. Announcement is made that with the exception of the "trimmings," which will increase the height of the dam to 140 feet, the Standley Lake irrigation project, which will furnish water for 210,000 acres of land north and east of Denver, is finished. To build the reservoir 3,000,000 cubic yards of earth were excavated.

The Fountain Chico Irrigation System, through its attorney, John T. Barnett, appeared before the State Land Board and asked for the temporary segregation of 15,000 acres of public land in El Paso and Pueblo Counties. The segregation was granted.

Work on the Big Park project, the largest on the western slope this year, has been started and will be rushed to completion. Water from the Little Dolores and East Creek will be conveyed in a canal 17 miles long to the 20,000 acres of dry farming land in the Big Park section. Water will be flowing on the land in time for crops next summer.

The Gunnison tunnel, and all irrigation systems in connection with it, are to be finished at once, according to reports given out by Engineer C. P. Pease, Secretary J. J. Tobin of the Water Users' Association, and District Engineer Walter. The largest construction work to be undertaken is the West canal, which covers all the high mesa land on the west side of the Uncompahgre River.

MONTANA.

The Winnett Irrigation Company, at a meeting held recently in Lewistown, awarded a contract for the construction of the intake lake, which is to be completed this fall. The tract of land to be reclaimed lies north of Winnett and contains about 15,000 acres, something like 10,000 of which has been filed on under the desert act and is controlled by individuals.

The Huntley irrigation canal is to be extended, which will include the installation of a lateral system in the vicinity of Bull Mountain and Anita.

Surveys, in accordance with the plans of the Three Forks Land Company, to construct a series of reservoirs in Boulder Cañon for the purpose of storing water to reclaim a vast tract of bench lands lying to the east and north of Twin Bridges, have been completed. If carried through to completion the project will be one of the largest of its kind yet undertaken in southern Montana.

About 60 men are employed working on a big irrigation project just east of Thompson, operating a sawmill for the manufacture of lumber for the flume, excavating grade for flume-boxes, building roads and preparing for the erection of the dam. The project, when completed, will bring under cultivation something over 4,000 acres of land.

NEW MEXICO.

Sixteen reclamation engineers are camped at Vado engaged in completing the survey of the distributing laterals along the foothills east of the valley from the point where they dropped it a month or more ago.

A tract of mesa land consisting of 25,000 acres near Las Cruces was recently sold to a party who contemplates entering the fruit business on a large scale. It has long been conceded that the sandy mesa lands are excellent, but the question of irrigation has been a drawback. Not until the valley lands became so high did people turn to the mesas.

OREGON.

As a result of the favorable action taken by the board of engineers, the construction of the Poe Valley extension of the Klamath project by the Reclamation Service seems assured. When this extension is completed 7,000 acres more will be under ditch. The included territory is in North and South Poe Valleys and along the southeast side of Lost River.

Plans are being perfected to irrigate another 10,000 acres of arid land near Ontario and an electric pumping plant is to be installed in Snake River, some four miles north of the town, to supply water to a portion of Dead Ox Flat.

The Chicago-Rogue River Company is repairing the Ament dam for the purpose of furnishing irrigation for the land in the vicinity of Grant's Pass and is now using the ditches already constructed. This winter they plan to extend the ditches so as to take in thousands of acres for the season of 1912.

At a meeting of the Desert Land Board recently the Chiawaukum Carey Act land project was canceled. The board reached the conclusion that no work has been done on the project and that none would be done. The project was in the hands of the Portland Irrigation Company.

Considerable progress is promised of the Klamath reclamation project this year. The large diversion dam and the canal, which will turn the flood waters of Lost River into the Klamath River, are assuming proportions, and the indications are that both will be completed on schedule time.

Farmers and fruit-raisers interested in the Josephine County Irrigation and Power Company met recently to consider the advisability of going ahead with an irrigation district, as ordered by the County Court on petition, or countermand the instructions to that effect given the board of directors. It was decided that the best interests of the community would be served by dissolving the proceedings for an irrigation district. This gives a clear field to the Chicago-Rogue River concern to proceed with the ditches.

UTAH.

It is reported that a syndicate of French capitalists has proffered to finance an irrigation project which is to take the waters from the Weber River down through Provo Cañon to irrigate the western part of Utah Valley, Cedar Valley and the western part of Salt Lake County. It is said that the project would cost $6,000,000 and that the Frenchmen are ready to put up $10,000,000 if necessary.

For the purpose of reclaiming thousands of acres of land, which at present it is impossible to cultivate on account of the scarcity of water, a high line irrigating ditch will be built in the near future along the southwestern portion of the Salt Lake Valley. Prominent business men of Salt Lake City and Provo are behind the project.

Irrigating companies of Plain City and Hooper were recently notified that they would have to look to the governor of the state to appoint water commissioners. On account of the low water the companies asked the commissioners to appoint a water master for each of the streams that feeds the ditches in the neighborhood.

The Teasdale Irrigation Company, of Teasdale, Wayne county, Utah, filed articles of incorporation with the secretary of state to carry on a general irrigation project business. Capital stock, $10,000, divided into shares of $5.00 each.

WASHINGTON.

September 4 is the date set for a hearing by the Public Service Commission at Pasco of a complaint against the Burbank Irrigation Company at Two Rivers, which, it is claimed, is not living up to its agreement to furnish water to certain landowners.

Arrangements for the delivery of storage water to the Yakima Indian Reservation ranchers for irrigation purposes for the remainder of the season have been completed by the United States Reclamation Service, according to the announcement of Acting Engineer A. H. Gulluckson. The water will be charged for at the rate of $1.00 per acre.

Three federal land experts have officially confirmed previous reports as to the availability of the prairies south of Tacoma for agriculture under irrigation. They place the arable acreage at about 100,000.

Cooke & Sons of Spokane, were granted an extension of 34 days on the contract for the completion of the main laterals in the Cowiche-Yakima branch, Tieton unit, Yakima irrigation project. The contractors were delayed by reason of additional work required by the Reclamation Service.

The government has awarded contracts for constructing canals and structures on the Prosser Division of the Sunnyside unit of the Yakima irrigation project, as fol-

lows: To Orrin H. Stratton of Spokane, Washington, one 180-foot steel bridge span complete in place, two 132-foot span and one 50-foot span in place. Contract price, $12,000. To the Pacific Tank and Pipe Company of Portland, Oregon, contract for the furnishing and placing of wood stave pipe, bridge floor, blow-off, contract price, $18,972. To Barnard Bros. of Prosser, Washington, trench for pipe, and canal excavation. The work involves the excavation of 35,740 cubic yards of material and 1,000 cubic yards of blanketing. Contract price, $18,830. The work of construction of the diversion dam and steel flues will be performed by force account.

MISCELLANEOUS.

The biggest irrigation project yet coming before the Board of Agriculture was recently filed with Secretary Ben Hennessy, State Engineer, with an application for water rights from the Cimarron River, Cimarron County, Oklahoma. The water is to be taken before the stream reaches the Oklahoma salt beds. Back of the application is the Cimarron Canal and Cimarron Reservoir Company. Plans of the company call for irrigating 120,000 acres in Cimarron County.

The State Engineer of South Dakota has granted a permit to Gregor Cruikshank, of Sturgis, for the right to appropriate one second foot of the waters of Bare Butte Creek for the irrigation of 70 acres of land in Meade County.

The Denver-Laramie Realty Company has a large force of men and teams at work upon an irrigation project 12 miles south of Laramie, Wyoming, where they expect to construct a mammoth reservoir. The land which it is expected to reclaim through this project lies but three or four miles from Laramie and is as rich as any in the country. It is likely that Laramie will have an entirely new agricultural community right at her doors before another year has passed.

It is quite evident that the Big Lost River Irrigation Company has given up the idea of doing anything in the way of construction work, for the present at least, as all the force employed on the project has been called off, including the Arnold engineering staff, which was re-surveying the project in an effort to perfect plans for the successful completion of the project.

The Irving pasture lands in Pecos, Brewster and Jeff Davis Counties, Texas, have just been sold to Kansas City capitalists, who propose to develop an irrigation project whereby at least 20,000 acres in the Cuyanosa Valley will be brought under cultivation. There are more than 40,000 acres in the pasture. The price paid for these lands is stated to be in the neighborhood of $800,000.

Another large irrigation project is in progress near Marfa, Presidio County, Texas. A large Kansas City irrigation company owns 13,000 acres of land near that place and will construct a dam across the Alamito Creek. The structure will be 997 feet long and 108 feet high. With the exception of the Medina River dam, now in course of construction, this will be the tallest dam in the state of Texas.

September 16 has been set for the election day when the matter of organizing the union irrigation district, the first in the state of Texas, will be submitted to the residents of the Raymondville district. The district comprises 185,000 acres land and the completion of the system contemplates the expenditure of nearly $3,000,000.

It is reported from San Antonio, Texas, that another big project is to be put through by the Medina Irrigation Company, of which Dr. F. S. Pearson is the head, and this is the diversion of the flood waters of the Guadalupe River into the Medina River above the dam.

Because of the extended years of drouth, farmers in Central Wisconsin are installing irrigation plants. One farmer near Neenah raised twice as much oats and barley as he did years ago without irrigation.

Kuhn, Loeb & Co., of New York, one of the greatest financial institutions of the United States, behind which stands J. Pierpont Morgan and other great financiers, has taken over the Buhl interests in the irrigation of 60,000 acres of land located in the southern part of Idaho.

Several quite extensive irrigation propositions are being established in the central and western South Dakota by private landowners. One party at Bixby, on the Moreau River, has purchased a pumping plant and will irrigate several hundred acres on a private scale entirely. Near Fort Pierre a couple of plants are in operation and a third one to irrigate more than 1,000 acres will be installed in a short time.

NEW CORPORATIONS.

Articles of incorporation were recently filed by the Ontario-Nyssa Irrigation company to construct irrigation works in Malheur County, Oregon. The capital stock of the new company is $150,000.

The Tacoma Upland Irrigation Company, of Tacoma, Wash., has filed articles of incorporation with the county auditor. Capital stock is $250,-000.

The Zimmerman Land & Irrigation Company, of Zimmerman, Pecos County, Texas, has recently filed its charter with the Secretary of State. The company is capitalized at $200,000. The incorporators are Davie Zimmerman, James W. Fogelman and Silas E. Rice.

The Klickitat and Columbia River Land and Irrigation Company, of Lyle, Washington, has recently been incorporated by Mr. George S. Canfield and his associates. It is generally known about Lyle that Mr. Canfield and his associates are the owners of some choice lands in that vicinity and that now, through a company, they will proceed to develop their holdings.

Articles of incorporation have been filed by the Pine River Irrigation Company at Durango, Colorado. Incorporators are D. C. Coulson, L. P. Sasebee and W. E. Duggan. The company is incorporated for $50,000.

Send $1.00 for The Irrigation Age one year and The Primer of Irrigation, paper bound.

Articles of incorporation of the San Miguel Irrigation and Land Company, a new corporation formed on May 11, 1911, with a capitalization of $1,000,000, have been filed. The directors named in the filing are A. D. Marshall, G. F. Beckwith, S. H. Klakelee, Carmen Layton and T. M. Morrow. Its interests are in the west end of San Miguel and Montrose Counties.

The Alamo Irrigation Ditch Company, of Hanford, Texas, has filed its charter with a capital stock of $1,000. Incorporators are J. W. Wright, E. C. Crosby and Tom Crosby.

The Broadmoor Lateral Company, an irrigation proposition, has been incorporated at Basin, Wyoming, with a capital stock of $2,250.

Myton Canal and Irrigation Company of Myton, to carry on a general irrigation business, owning rights in the Duchesne river; capital stock, $50,000 in $10 shares. John T. Howland, president; C. T. Boggs, vice-president; S. S. Duhondorff, secretary and treasurer.

Tremonton Land and Irrigation Company of Tremonton; capital stock, $20,000. Officers, F. C. Elliot, president; J. Y. Ferry, vice-president; S. N. Cole, treasurer.

The Utah-Arizona Irrigation Company; capital stock, $100,000. The officers are J. A. Gueren, president; Robert I. Fischer, treasurer; Adolph H. Easter, secretary. The company takes over holdings in the Virginia river district.

Myton Canal and Irrigation Company of Myton; capitalization, $50,000. Officers of the company are John T. Howland, president; C. T. Boggs, vice-president; S. S. Dubondorff, secretary-treasurer.

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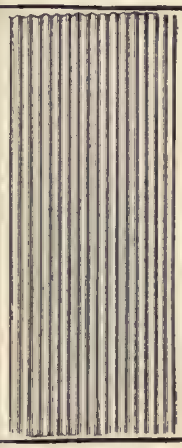

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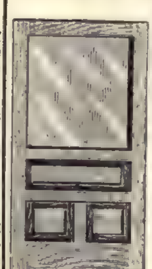

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TRUCKEE-CARSON IRRIGATION PROJECT, NEVADA.

The first crop of alfalfa on this project has been somewhat retarded by the unfavorable climatic conditions. The second crop, however, is making unusually rapid growth and it is expected the total yield will approximate the large yield of last year.

The new sugar-beet factory will be ready to handle the crop of sugar-beets, of which about 1,000 acres have been put in this year.

Excellent progress is reported on the construction of the Lakontan dam on Carson river and the installation of machinery for the power plant is progressing rapidly.

Report from the Orland irrigation project, California, indicates that about 3,600 acres of land have been receiving water from the project system on a temporary rental basis established for the time being. The showing made is very satisfactory and the new lands put under cultivation are presenting a very promising appearance.

Excellent progress is being made on the construction of the dam at the outlet of Lake Kachesa on the headwaters of the Yakima river, state of Washington. The reservoir when completed will add materially to the amount of storage available for the various units of the Yakima project.

Very satisfactory crop conditions are reported from the Klamath irrigation project in Oregon. Many of the farmers have made bumper crops, and the value of irrigation in this section is regarded as beyond all question.

Settlement in the country districts is increasing very rapidly, as shown by the fact that three new school districts have been organized in Klamath county since spring and the old districts are showing an increased enrollment.

The Secretary of the Interior has withdrawn from all forms of entry 14,720 acres of townships 20 and 21 N., Ranges 15 and 16 E., in Washington, pending an investigation of a possible reservoir site in connection with the Yakima irrigation project. The lands include a portion of a tract temporarily withdrawn by the Forest Service.

The Secretary of the Interior has awarded contract to J. D. Glass of North Yakima, Wash., for the construction of two frame patrol houses and one frame cottage to be used in connection with the Tieton Unit of the Yakima project, Washington. The contract price is approximately $3,451.26.

Supreme Court Decisions

Irrigation Cases

REASONABLE USE OF WATER.—

Since an irrigator is only entitled to so much water as he can use beneficially without waste, a custom among irrigators to let the water flow continuously would not control as against reasonable regulations adopted by an irrigation company pursuant to the water contract by which an alternating flow was followed.—*Shafford* v. *White Bluffs Land & Irrigation Co.* Supreme Court of Washington. 114 Pacific 883.

ABANDONMENT.—

To justify the finding of an abandonment of water rights, the circumstances must justify an inference of an intention to abandon and to leave the water rights to be taken by any other person who chooses to do so; but mere lapse of time during which there is nonuser is not sufficient.—*Featherman* v. *Hennessy.* Supreme Court of Montana. 113 Pacific 751.

KNOWLEDGE OF DIVERSION.—

Defendants by permitting plaintiff without objection to construct a dam and flume to divert the waters of a stream did not estop themselves from asserting their water rights in the stream where they had no reason to believe at the time that plaintiff intended to divert water to which they were entitled.—*Logan* v. *Guichard.* Supreme Court of California. 114 Pacific 989.

CONTRIBUTION TO REPAIR OF DITCH.—

In a suit to determine the rights of the parties in an irrigation ditch, evidence *held* to require a finding that complainant was only entitled to two-fifths of the water flowing in the ditch, while defendants were entitled to the remaining three-fifths, and that the parties were bound to contribute, to keep the ditch in repair, in the same proportion.—*Stewart* v. *Austin.* Supreme Court of Colorado. 115 Pacific 516.

SALE OF LAND THROUGH WHICH DITCH RUNS.—

Where one buys land through which an existing irrigation ditch is in operation, he takes the land subject to the right of the ditch owner to maintain and use the same as before, said right being in the nature of an easement in the lands through which the ditch runs; the legal title being in the owner of the servient estate.—*Arthur Irr. Co.* v. *Strayer.* Supreme Court of Colorado. 115 Pacific 724.

WASTE WATER.—

Where plaintiff was entitled to the unobstructed use of waste water as the same should be discharged into her ditch at the terminus of a particular lateral connected with an irrigation system, defendants could not willfully and maliciously discharge water as waste and at the same time invoke the rule that they were not bound to maintain conditions so as to supply plaintiff's appropriation of waste water at any time or in any quantity.—*Green Valley Ditch Co.* v. *Schneider.* Supreme Court of Colorado. 115 Pacific 705.

COMPENSATION OF WATER COMMISSIONER.—

Under Mills' Ann. St. § 2387, entitling a water commissioned to pay from the counties in which his district lies, one of three counties in which a district lies is liable for one-third of his compensation, though no services have been rendered in that county, though decreed priorities have not yet been established for ditches therein, and though there is less land irrigated in the county than in either of the other two counties. —*Board of Com'rs of Clear Creek County* v. *McLean.* Supreme Court of Colorado. 115 Pacific 525.

TIME OF APPROPRIATION.—

Where an appropriation of water had been made to operate a mill, a subsequent use of that water for agricultural purposes must, under Rev. Codes, § 4842, providing that though an appropriator may change the point of diversion of water or use it for other purposes, he may not do so to the injury of subsequent appropriations, § 4845, providing that between appropriotors, the one first in time is first in

(Continued on page 1080.)

(Continued from page 1078.)

right, and section 4844, requiring an appropriator to return the water to the stream when he has finished his use, he considered a new appropriation.—*Featherman* v. *Hennessy.* Supreme Court of Montana. 115 Pacific 983.

Disputed Title.—

Where, in a suit to restrain the conversion of the waste waters of a stream by the construction of a dam, complainant claimed to own the dam and reservoir site and also land below the dam under a wagon road grant which expressly reserved all lands containing mineral, and defendant denied plaintiff's ownership, and claimed that the land was in fact mineral and so reserved, defendant was entitled to a trial of the issue of complainant's title to a jury, and hence a court of equity would not oust defendant's possession or enjoin it from using the premises until complainant's title had been established at law. —*Eastern Oregon Land Co.* v. *Willow River Land & Irrigation Co.* U. S. Circuit Court, District of Oregon. 187 Federal 466.

Approval by State Engineer.—

Water Code (Laws 1909, p. 333) § 47, requires the state engineer to approve all applications made in proper form which contemplate the application of water to a beneficial use, but provides that, when the proposed use conflicts with determined rights or is a "menace to the safety and welfare of the public," the application shall be referred to the board of control for consideration, and it shall order the refusal of the application if the public interest demand it. *Held,* that the state engineer was not bound to approve an application for an appropriation or for a reservoir, intended for a public beneficial use, if the beneficial use was not available to the applicant, though the application stated that the appropriation was for a beneficial use.—*Cookingham* v. *Lewis.* Supreme Court of Oregon. 115 Pacific 342.

Diversion.—

Where a complaint by a riparian proprietor to restrain defendant from diverting the water of a river by taking water from a creek above complainant's riparian lands alleged that the creek was a tributary of the river, and that defendant diverted from the creek 150 inches of water, thereby lessening the flow of water in the river and depriving complainant of the flow to which it was entitled as a riparianist, an injunction pendente lite issued on such complaint was not objectionable because it was not proved by other evidence that complainant was either entitled to the flow of the water of the creek in a natural and usual channel through complainant's land, and that its land was riparian to the water of the creek, or that complainant was an appropriator of a water right with the particulars as to the means and method of complainant's diversion or appropriation and continuance of its use.—*Porters Bar Dredging Co.* v. *Beaudry.* District Court of Appeals, Third District, California. 115 Pacific 951.

Quantity of Water to Be Supplied.—

To secure a definite water supply, ditch owners entitled to one-half the waters of a stream contracted with an irrigation company that surplus waters might be disposed of by the company. The contract provided that substantially one-half of all water taken from the stream, aside from that supplied from the company's reservoir, should flow into the ditch. *Held* that, if the contract was intended to require one-half of the water of the river to be put into the ditch regardless of its beneficial use by others and of its use by the ditch owners, the last-mentioned provision is invalid; neither probable future need of that quantity by the ditch owners nor porous character of the ditch resulting in seepage loss constituting ground to sustain such provision.—*North Fork Water Co.* v. *Medland,* U. S. Circuit Court, Southern District of California, 187 Federal 163.

Pine Creek Irrigation Company has plans to expend about $350,000 for dams and ditches near Weston, Ore., where 8,000 acres of land will be made more productive by the application of water. Engineers of Spokane and Walla Walla report that the project is feasible. The dam will be 300 feet in length and 150 feet high. It will be constructed of concrete and earth. G. W. Probstel of Weston announces that work will begin in April and that it is expected to have the plant completed for the irrigation season of 1912.

Development of 30,000 acres of fertile farm land will be brought about by draining Calispel lake in the Pend Oreille valley in northeastern Washington. Water rights have been filed on Calispel creek to supply 14,000 acres. By diverting Calispel creek and keeping out the flood waters of the Pend Oreille river with a new diking system it is expected the 3,500 acres composing Calispel lake will be reclaimed. The rest of the acreage will be watered from the Pend Oreille river. The Idaho & Washington Northern Railway Company is building branch lines into the district.

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CONSERVATION OF WATER POWER.

Investigations of possible sites for developing water power on the public domain are being pushed by the United States Geological Survey, with resulting withdrawals of land from entry where it is found that valuable sites exist. In July 31,725 acres of such land were withdrawn, including a great number of power sites. No estimate has been made of the horsepower involved, but owing to the character of the power sites withdrawn it is believed to be very large. These July withdrawals make a total outstanding area withdrawn of 1,546,258 acres, based on the examination and recommendation of the Geological Survey, and involving thousands of power sites and doubtless millions of horsepower. The withdrawals are made in aid of proposed legislation by Congress which shall provide for the fullest possible development of these enormously valuable properties and at the same time guard the public interests.

One of the new courses of study offered by the Missouri College of Agriculture is a four years' course for women, leading to the degree of Bachelor of Science in Agriculture. This course is intended to give to women, not only a knowledge of home economics, but a thorough training in those farm practices in which women are particularly interested. The course includes Farm Crops and Soils, Dairying, Botany, Gardening, Care of Flowering Plants and Fruit Culture, besides the usual studies that have heretofore been included in the regular home economics course.

It is expected that this course will prove popular with a large class of young women who intend to spend their lives on farms or in teaching in connection with agricultural schools. It is a well balanced course, affording a wide range of studies from which students may elect work outside of the agricultural and home economics departments.

It is reported that the Culbertson irrigation ditch, the largest of its kind in southwestern Nebraska, has been sold by United States Senator Buckley of Connecticut to a Chicago company for $125,000. Senator Buckley bought the property some years ago. The new company, it is said, will develop this ditch by building a dam over Blackwood Creek between McCook and Culbertson. The people of Red Willow county feel that a new era of development has arrived.

ANOTHER SOUTH DAKOTA LAND DRAWING.

A large per cent of the 120,000 people who are expected to file for claims in Mellette and Bennett counties, South Dakota, will pass through Omaha and will be given an opportunity to see the Omaha Land Show at which the resources and opportunities of the entire West will be exploited. Thus it will be possible to directly interest thousands of persons who are actually seeking homes and who will be in the proper frame of mind to receive and absorb all the information that is thrust upon them.

As an example of the great number of land seekers who will pass through Omaha in October, it is set forth that in 1904 106,000 registered in Bonesteel. Four years later at the Dallas registration for Tripp county lands 114,000 seekers made filings. On these figures is based the estimate that there will be at least 120,000 registrations at Dallas, Gregory, Rapid City and Chamberlain, 60,000 of which will go via Omaha, and it will be likely to interest a great many of them in the opportunities offered in the region further west. The South Dakota registrations will be made between October 2 and 21, and the drawings begin October 24, while the Land Show will be from the 16th to the 28th. The dates of the show will give the homeseekers an opportunity of visiting in Omaha both before and after they go to South Dakota.

During the last South Dakota drawings most of the applicants came from Iowa, Illinois, Missouri and other states in the middle West, and the bulk of the coming registrations will be made by people from these states.

The Secretary of the Interior has awarded contract to the Lidgerwood Manufacturing Company of New York for furnishing three cableways for use in the construction of Engle dam, Rio Grande irrigation project, New Mexico. These cableways each have a span of 1,420 feet. They are to be operated electrically, each cableway adapted to operate a 3-yard Type B, Anderson-Evans grab bucket, or its equivalent, representing an average load of ten to eleven tons when filled with sand, or an average load of concrete of eight tons, operating with aerial dumping device. The contract price is $44,160.

Considerable areas of alfalfa under the Yuma irrigation project, Arizona-California, which have been allowed to go to seed are now being harvested, and yield as high as 800 pounds per acre have been obtained. Last year the prices paid for alfalfa seed ranged from 14 to 17 cents and indications are therefore that this will be a remarkably paying crop this season.

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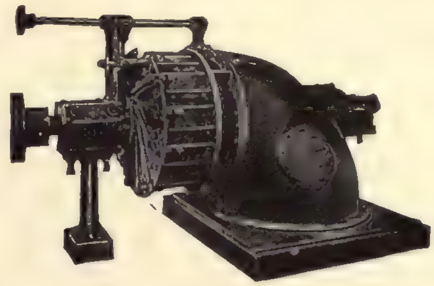

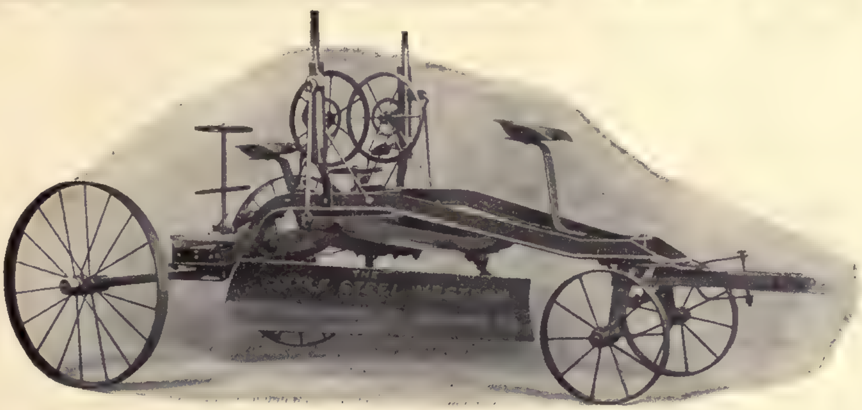

Twenty-sixth Year

THE IRRIGATION AGE

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THE IRRIGATION AGE

With which is Merged

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D. H. ANDERSON, Editor

ANNOUNCEMENT.

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CONTENTS.

Irrigation First, Then Population.

According to the census something like 15,000 families have taken up irrigated farms during the last year along projects which have been executed by the government. This is a satisfactory and encouraging record, when it is considered that this population is now residing on land that was formerly looked upon as desert and unfit for anything which under the magic touch of irrigation has been changed to splendidly productive farms and orchards. The great increases of population in the states of California, Oregon, Washington, Idaho, Montana, Colorado, Wyoming, New Mexico and Arizona are due in a great measure to the progress made in irrigation and there is little doubt but what this increase will keep up for years to come.

There is plenty of arid land yet to be reclaimed by the irrigator and there will be homes made available for thousands of families more in the near future. The government has many more projects under way and there are numerous private concerns which are developing big tracts of land by bringing water to it to make the rich soil capable of producing abundant crops.

It is estimated that the crops raised last year by the 14,000 families on government projects have a value of over 20 millions of dollars, which would be an average of more than 1,400 dollars per family. This is certainly a good showing, since many of these families are beginners and will do better in the future when they are fully acquainted with their surrounding conditions.

Causes of Poverty and Their Remedy

Several weeks ago there appeared in one of the daily papers an editorial headed, "The Chief Causes of Poverty," which gave some brief but very interesting information upon this subject. It appeared that in a recent investigation made in New York City out of 1,600 families only 2 per cent or 32 families were poor due to intemperance, and that desertions, imprisonment and inefficiency caused more cases of poverty than drunkenness. The two greatest causes of poverty, however, were found to be sickness and unemployment, they accounting for 66 per cent of all the cases investigated.

When it is considered that while there were these 530 families in New York City without work, there were hundreds of farmers in the West unable to hire help to harvest their crops, and who would have been glad to give work to the New York unemployed.

What is said of New York applies to all large population centers and it shows that something should be done to educate the laboring classes to the fact that the big cities are dangerous ground for any except the most robust and proficient, and that the country, while offering smaller wages, gives them many things the city cannot give, namely health and contentment in God's fresh air and beneficent sunshine.

Some reforms might even be advocated in the rural situation by suggesting to farmers who employ labor only for part of the year, to hire their help by the year and furnish house, garden, etc., for a hired family so as to give them assurance of steady employment. This would certainly be more desirable than to hire the laborers by the day and discharge them as soon as the work becomes slack; by hiring them by the year with assurance of making their living most laborers would be glad of the opportunity and become faithful and contented workers. The writer knows of several cases where farmers thus imported working families from a large city and settled them on their farms and where the results have proven very satisfactory, the expense for the whole year being but slightly more than formerly when the help was discharged during the winter months.

Under such conditions it should not be difficult for a farmer of even moderate circumstances to get the services of a city family on his farm, and getting the benefit of the labor of the whole family, which would tend toward a more intense cultivation of the land and consequent better crops. This would tend to relieve the congestion in the cities and build up rural districts which are now lying dormant for the want of proper labor to develop them.

It is truly time that people stop their mad rush into the city when health and happiness are begging them to go into the country to work the soil for abundant returns at harvest time, with many oportunities of acquiring land and becoming well to do farmers in the end.

The Safety of Dams Must Be Looked After

Within the last two weeks two dams have given way in this country, scattering death and desolation in the wake of the released waters. The breaking of the dam in Austin, Pa., caused the death of several hundred people and the destruction of much valuable property. The giving away of the dam in Black River, Wisconsin, while not accompanied by much loss of life, has destroyed a whole city of 2,000 people, making them all practically homeless and doing damage amounting to several millions of dollars.

In the case of the catastrophe in Austin, Pa., it appears from the information available at this time that a manufacturing concern using the stored-up waters behind the dam is criminally responsible for the terrible results following the breaking of its dam, since the dam had been officially condemned by expert engineers about a year ago. The repairs needed to make it safe and staunch were estimated by the expert to require the expenditure of something like $25,000. This sum of money looked too big to the corporation and hence kept using the dam in its defective condition until the awful catastrophe finally occurred, almost annihilating the people and buildings of a whole town.

This is a terrible lesson, but it should be learned and it teaches that dams holding back large bodies of confined water are dangerous and that they must be inspected periodically by competent authority; and, furthermore, laws should be passed either in each state or by Congress compelling immediate attention to the recommendation of such official inspectors, and vesting the state with authority in case private corporations fail to make the required repairs, to make such repairs forthwith and charge the cost to the owners of the dam. If such a law had been in effect in Pennsylvania the shocking loss of life and property would have been avoided.

The Financial Situation in the State of California.

Some of our California friends are quite exercised over the attitude assumed by the San Francisco bankers relative to the irrigation bond securities.

It is perfectly proper for a bank or other financial institution to closely and thoroughly examine into the character of securities offered as collateral for loans, and if such examination discloses the fact that the basic enterprise does not promise success, then it is natural that the banker should reject the proposition. But if, on the other hand, such bonds are issued by districts which embrace actual irrigation tracts, which are actually distributing water to actual settlers raising crops, proving that the enterprise is on a paying basis or nearly so, and that no default has been made in the payment of interest, then banks are doing wrong in refusing loans on such bonds, especially as there has been recently a law passed in California providing for the making of irrigation bonds recognized securities for loans and legal investments of banking, savings, insurance and school funds under certain restrictions.

These restrictions relate briefly to newly organized districts, in which case a commission is provided which must pass upon the bonds and authorize them as investments. There is, of course, no way to compel the San Francisco bankers to invest even in the best irrigation bonds that were ever placed on the market if they don't want to, but it is certainly a piece of short-sightedness on their part to interfere with the development of the resources of the state of California, which will gradually affect the prosperity of the banks adversely.

Suspicion is pointing to the comparaticely low rate of interest earned by the irrigation bonds as being the principal reason for the action of the San Francisco bankers and that industrial bonds paying a higher rate of interest are much more attractive fields for them as investments.

Whether this could be offset by the great permanence and security of the irrigation investments is an open

question and no doubt depends upon the condition of the money market.

The situation is undoubtedly one of great difficulty and should be handled with good judgment and circumspection.

Our Ancient and Unsatisfactory System of Measures and Weights. Our present system of measures and weights is possibly the greatest burden and drawback, acting as a brake on our national progress which we have to contend with. Next to England among the civilized nations, our methods of measuring and weighing are the most cumbersome and unsatisfactory. It is true England is going us one better, for there, in addition to adhering to a most unsatisfactory system of measures and weights, they are burdened with an equally unsatisfactory monetary standard which has only one redeeming feature, that it shows true British persistence and tenacity. Here in the United States we have a truly admirable standard of money, properly and efficiently based upon the decimal system and so thoroughly made part of our institutions that the American dollar, dime and cent are precise and easily handled units in any computation.

Why the United States at the time this decimal system of money was adopted did not introduce at the same time a decimal system of measures and weights may be difficult to state at this time, but is probably due to the fact that England had already, by surveys and commerce introduced its system into the American colonies, so that its continuance was just a matter of course.

More than 40 years ago Congress legalized the use of the metric system of measures and weights within the United States, but beyond a limited use in scientific schools and by the government in certain kinds of work no progress has been made toward reform in this direction. Even our neighbors across the Rio Grande can show us where we are far behind them when it comes to measuring or weighing, for one of the good things Diaz has done for Mexico is the adoption of the metric system of measures and weights.

There can be no good argument adduced why our "foot" should be divided into 12 inches and the yard into 3 feet, and the rod into 16½ feet, and the mile into 5,280 feet.

Nor is there any good reason why one gallon should contain 231 cubic inches, and why one pound should have 16 ounces for one class of merchandise and 12 ounces for others. The whole system looks ridiculous were it not for the seriousness of the attending loss in time and vexations. Just think of the work necessary to convert, for instance, gallons into cubic feet; first multiply by 231 and then divide by 1728. If the subdivision were all made on the decimal system all that would be necessary would be to shift the decimal point. Thus, if 10 inches were equal to one foot, and if 100 cubic inches equaled one gallon, then 61 gallons would be 6,100 cubic inches or 6.1 cubic feet. Compare the two methods and see the time saved by the latter operation.

There is no doubt some prejudice fighting for the retention of the old system on account of the foreign terms which would have to be adopted, together with the metric system, and it would greatly upset our established geographical lines and land boundaries, which are now based upon the mile of 5,280 feet. The writer developed a decimal system of measures and weights adaptable for the United States, wherein the mile, as established at present, forms the unit for all measures and weight, but wherein all subdivisions are based upon the decimal system. This will be elucidated in the November issue of the Irrigation Age.

In this connection it may also be remarked that reform in this direction will not become a fact unless simultaneous efforts are made throughout the whole country. It is strange, to say the least, that our public educators have done so little toward this work. In a progressive country like ours, every boy or girl graduating from the grammar school should know the principal features of the metric system. When Germany introduced the metric system it was principally done by thoroughly educating the children in the public schools in the new method, and lo, the change was easily and thoroughly made.

Uncle Sam should do likewise.

Knowledge Needed to Supply the Right Amount of Water. The Irrigation Age has repeatedly called the attention of its readers to the importance of using water on irrigated lands according to well-developed principles; either too much or too little will bring unsatisfactory result. Too much water, however, will cause more damage than if sufficient moisture is not applied, and there have been cases recently investigated by the government in several of the Rocky Mountain states where serious deterioration of orchards has occurred, due to too abundant supply of water.

The government has now fruit and soil experts in these states studying the effect of the methods in use and recording the effects upon fruit and soil. The values of many orchards which formerly brought high-priced crops have declined amounting to many millions of dollars.

It is hoped that the efforts of the government will result in the establishment of good and reliable information upon this subject, so that the valuable land planted to oranges, apples and pear orchards will be kept up to standard conditions, and especially not spoiled by too much water, since this valuable fluid should be made use of to serve more land rather than destroy.

It is time also that the irrigators study more clearly the requirements of their farms or orchards rather than guess at the amount of water needed, and the efforts of the government in developing exact laws or rules for the various phases of irrigation should be earnestly supported by the states interested and all possible aid should be given.

Likewise the work of the various experiment stations should be kindly received and the information published by them should be carefully read and studied by the irrigators or farmers interested.

Thoughts That Come and Go. The bonds of successful irrigation enterprises should certainly be preferred to some wild-cat industrial or mining schemes—San Francisco bankers, please note.

* * *

The Irrigation Age keeps its readers in constant touch with everything pertaining to irrigation and allied works. Its advertising columns tell you where to get anything you need, from reapers down to a hoe.

* * *

No one ever learned too much; even the wisest can expand their knowledge sometimes by watching people perform the lowliest tasks.

Irrigation in The Northwest

By R. Insinger

Chairman Board of Governors, Nineteenth National Irrigation Congress.

Keen interest is manifested throughout the Northwest in the 19th National Irrigation Congress in Chicago, and indications are that the Pacific slope and intermountain country will be well represented at the sessions, December 5 to 9. Districts in Washington, Orgon, Idaho and Montana, where large areas of land, at one time thought to be worthless for agricultural purposes, have been reclaimed, are arranging to send delegates and make exhibits of their products at the United State Land and Irrigation Exposition in the Coliseum.

I feel confident there is more genuine interest in many parts of the Northwest today in the National Irrigation Congrss than there has been at any other time since its organization. The reason for this becomes apparent when it is understood that while the development and progress of the country has been rapid and substantial since the introduction of irrigation, the problem now confronting the people is the necessity of attracting ambitious workers to the land by inducing them to invest some capital and labor in an industry that pays satisfactory returns for intellectual and persistent effort.

The coming congress means much to the entire western country, and its influence in directing the attention of thrifty men and women, seeking profitable openings, to the vast areas of undeveloped land and the opportunities and advantages presented for mixed farming, fruit-growing and truck gardening is a matter that merits the best thought and efforts of the officials and members of the organization. Moreover, as I pointed out in a previous article, this gathering will afford irrigationists the opportunity to present their projects to the investing public, as well as to the heads of financial houses.

The eastern investors, formerly large buyers of irrigation securities, have been holding off of late, owing chiefly to misleading statements published in certain magazines that irrigation generally is a gambling proposition. In other words, that it is in a precarious condition. The writers of these statements have, however, in nearly every instance refrained from mentioning the fact that every financially responsible project, designed to reclaim land by irrigation, whether by pumping, gravity or syphon, constructed under the direction of competent engineers, is today successful in doing its work and paying adequate returns on the investment.

The economic value of the science of supplying the land with moisture by artificial means is no experiment; it has become so thoroughly established in the western country that the vast expanse, once called "The Great American Desert," is bound to become the home of the highest agricultural civilization on this continent. Where the pioneers toiled in the sagebrush country, when not fighting off hostile Indians, there is today a crop-producing, home-supporting area of inexhaustible fertility, greater in extent than the cultivated lands in the New England and several adjoining states and capable of supporting a larger rural population.

Irrigation has developed the most scientific farming, which, in turn, has produced large profits on small areas of land, thus creating great wealth and making a dense population. That which is possible is actually coming to pass, as the well-developed country districts in the Northwest, especially those in the states of Montana, Oregon, Washington and Idaho, are so thickly populated they appear much like the suburbs of cities. Here the apple, unequaled anywhere for flavor, color, size and uniformity, has created nine to ten tons of freight to the acre where thirty bushels of wheat produced less than one ton, also made tonnage where only sagebrush and tall pines and other trees grew.

It has been demonstrated in Washington, Oregon, Idaho and Montana that under irrigation these former sagebrush wastes and cut-over timber lands will produce paying crops of anything which grows in the temperate zone. The products are noted for their brilliant coloring, unusual size and excellent flavor and they command the markets of the world. Vegetables and root crops in almost endless variety and tree and vine fruits follow each other in rotation and fill out the season.

Several hundred private projects are in successful operation in the Spokane district. Where soil and water conditions, engineering requirements and financial responsibility have been properly considered there has never been a single failure. The most important of these works is in Chelan county, Washington, which has the Wenatchee, Chelan and Entiat valleys. There are also modern works in the Spokane valley, where large crops of apples, berries, sugar beets and other vegetables were harvested this year on irrigated land. It is estimated that 90,000 acres of land in the valley is adapted to irrigation. The Spokane river, nearby lakes and an underground stream, flowing through the valley, are used by these plants, one of which raises the water by means of electric pumps from wells, ranging from 97 to 140 feet. The capacity of this apparatus is sufficient to water 3,000 acres of land. There are also large plants along the Columbia river and in the Kettle Falls, Bitter Root, Snake river and Clearwater valleys.

Scores of gravity, syphon and pumping plants are in successful operation in various parts of the district. The extent of operations on irrigated lands in the Northwest will be better understood when it is known that the value of the apple and other fruit crops in the Spokane district alone amounted to $20,000,000 last year. It should treble that sum in a few years, by which time several million trees set out in the last three years will come into bearing and others planted prior to 1906 will have reached maturity.

The largest of the United States government's works in Washington is the Sunnyside project, in the Yakima valley. This covers 90,000 acres. The cost is estimated at $1,600,000. There are sixty miles of main canals and 100 miles of laterals. The Tieton canal, twelve miles in length, in the same valley, is designed to water 30,000 acres of land. The estimated cost is $1,800,000. The combined length of the three main laterals is twenty-five miles.

The Wapato project, also in the Yakima valley, will eventually cover 120,000 acres at a cost of $1,500,000. The original works cover 40,000 acres, with twenty-five miles of main canal and fifty-five miles of laterals, built at a cost of $250,000. Its extension provides for twenty-five miles of laterals in three sections. This means that 240,000 acres of land will come under the government canals. The estimated cost of the work is $4,800,000.

The Okanogan project, in the county of the same name, in north central Washington, will water 8,000 acres at a cost of $500,000. In addition to these, the government has authorized the Kittitas and Benton projects, in central Washington, covering several hundred thousand acres. The Indian Service estimates that $25 or less will cover the cost for water rights on the reservation. This is about 50 per cent of the cost of watering land under other canals in the valley. There are also numerous successfully operated private irrigation projects in the Yakima valley.

Government officials report that eventually more than $50,000,000 will be expended by the Reclamation Service in the state of Washington in reclaiming 1,500,000 acres of land, now entirely or partly waste. Fifty thousand acres are in the Ellensburg district, 200,000 acres in the Rattlesnake and Coal Creek districts and 10,000 acres in the valley of the Okanogan.

The government projects in southern Idaho are the Minedoka, with an area of 160,000 acres, completed at an estimated cost of $4,000,000, and the Payette-Boise, 200,000 acres, costing $3,000,000. The Payette-Boise project covers at present the largest single tract in the United States. Oregon has the Umatilla project, 18,000 acres, costing $1,100,000 and the Klamath, part of which extends into California, 120,000 acres, cost $3,600,000.

Montana has the Milk River, Saint Mary, Lower Yellowstone, Huntley, Sun River, Blackfeet, Flathead and Fort Peck projects, which contemplate the watering of 949 acres. There are also several hundred thousands acres to be irrigated by private projects.

There is nothing problematic about the projects in operation or under construction in the Northwestern states. We have soil, climatic and other conditions, and the lakes, rivers and creeks in the Columbia basin alone, estimated to contain fully 3,500,000 electrical horsepower available for development purposes, afford ample water to irrigate a hundred times the acreage now under cultivation and provide homes for from 30 to 35 per cent of the population of America. As it is, the modern method of intense cultivation is building new communities and adding millions of dollars of new wealth annually to the nation's assets.

THE TRUTH ABOUT FARM MACHINES.

By Edwin L. Barker.

The International Harvester Company's answer to the so-called Townsend Report has left that document with more holes than are to be found in the seat of an up-to-date binder.

The report, in the main, consists of a group of untruths and misstatements of facts, many of which are easily recognized by farmers, dealers, and others familiar with harvesting machines and the harvesting machine industry.

The erroneous report, and the more erroneous "yellow" versions of it, could easily mislead those ignorant of harvesting machines and agricultural conditions. But not so the farmer and the dealers. They are well versed in the subject of farm machines, and since they are the more vitally interested, a brief summary of the report, together with a portion of the International Harvester Company's reply, may be worth a little space and time.

On July 26, 1911, there was received in evidence by the Stanley Committee, at Washington, then investigating the United States Steel Corporation, an unsigned document, which was said to be a copy of a report concerning the International Harvester Company, made by Burdette D. Townsend, Assistant United States District Attorney for North Dakota, in 1906. Even in the minor essentials, such as the names of the voting trustees, chairman of the board of directors, and the president, the report shows a woeful lack of investigation and intelligent consideration.

R. Insinger, Chairman Board of Governors, 19th National Irrigation Congress.

The report charges that of the nine different makes of binders purchased by the International Harvester Company at the time of its organization in 1902, all but three—the Deering, McCormick and Osborne—have been abandoned, and that repair parts are not furnished for any others.

Farmers, dealers, and, in fact, every man, woman and child at all familiar with farm machines or even with farm life, knows that such a charge is absolutely untrue.

The old Minnie, Buckeye and Keystone companies were practically out of business in 1902, being in the hands of creditors. The Keystone binder was an experimental machine, and only a limited number were sold during one season. But of the six other binders—Champion, Deering, McCormick, Milwaukee, Plano and Osborne—all have been and are today being manufactured, and are sold in the principal agricultural countries of the world.

Would the International Company continue to advertise these machines if they were not being manufactured? Well, hardly.

The report states that the International has been able to create a "monopoly" because the company owns the patents which protect the knotter in the self-binder.

Could a statement be more absurd? It is a well known fact that the Appleby patent on the knotter expired in 1896, and since that time there have been no existing patents upon any essential part of the binder. Today any man, or any organization of men, can manufacture binders without fear of prosecution or the payment of royalties.

The claim is made in the report that the International purchased several of the plants, including the Minnie, Buckeye, and Keystone simply to close them.

If this statement were not so serious it would be funny. Every plant has been enlarged and improved. And right now each of these plants is giving employment to more men than ever before.

Men whose memories go back no farther than ten or a dozen years, remember the fierce, demoralizing, cut-throat competition which existed between the various harvesting machine companies. They also remember that repair parts frequently were hard to obtain, and in some instances were not to be had at all. This brought untold loss to the farmers, crops suffered, and gloom settled over many a harvest field. One season a farmer would buy a binder, only to discover the next season that he could not obtain a repair part because the company had gone out of business.

The entire harvesting machine industry was in a demoralized state. This was the condition when the International Harvester Company was organized. Several of the plants were bankrupt and practically out of trade. Through the organization of the International, harmony was brought out of chaos, plants were restored to their full working capacity, machines attained a higher efficiency, repair parts for every machine were to be had, dealers found themselves upon a firmer footing, and farmers bought with greater confidence and surety.

Is there a farmer or dealer who would like to exchange the present for the past?

In spite of the report's charge of "monopoly," the International still has plenty of competition.

The Acme, Johnston, Wood, and Adriance-Platt companies are active in the binder trade, and these and several others in the mower field. During the past two years three other manufacturers have entered into this trade. Also may be mentioned the Minnesota State Prison Factory, which, with its prison labor and public funds, is forcing free labor and private capital into competition.

The report tries to make much of a "binder twine trust." There is no such thing as a "binder twine trust."

There are a half dozen or more competing twine manufacturers, to say nothing of the seven state penitentiary twine mills.

The quality of binder twine has steadily improved, while the prices have steadily fallen. Since 1902 the prices on binder twine have decreased about 40 per cent. Compare your 1902 bills with those of 1911 and see if this is not true.

But the dealers and the farmers—those who sell and buy binder twine—know this. They also know that the twine they now sell and buy is much better than the twine they sold and bought ten years ago.

The report has much to say about the prices of binders. This subject has been discussed over and over again. But to go to the bottom of prices, it is well to go back to the beginning.

In 1879 the twine binder was sold to the farmer for $360. In the eighties a binder cost $240; and in 1891, with the expiration of the basic patents, the current price was $140. When the International Company was organized, the price of a binder was about $125. This price has been maintained with but little variation, notwithstanding the fact that since 1902 binder materials, such as iron, steel, lumber and cotton duck have increased on the average more than 30 per cent, and the wages of labor employed have advanced about 27 per cent. Three years ago it was necessary to advance the price of a binder 7 per cent. Recently some of the raw materials have declined in cost to such an extent as to permit of a 5 per cent reduction in binders for 1912.

Today a farmer can buy a much better and more satisfactory binder for less than one-half the cost of a machine thirty years ago. Yet today the farmer, thanks to his more business-like methods, improved farm machines, the study of the science of agriculture, and the trade and agricultural press, does less hard work, and sells his crops for more money than he ever before received.

The report speaks of rebates from railroads, and of special concessions from the United States Steel Corporation. The International denies that it receives rebates from railroads or any special concessions from the steel corporation, and states that during the past seven years it has bought from the steel corporation only 10 per cent of its total needs.

In a discussion of prices, with which the report consumes much space, the fact that a modern binder is made up of more than 1,200 separately formed parts, and that every part must work with clock-like precision, is entirely overlooked.

Also, the cost of transportation, and selling is ignored,

as well as the expert service which is required with these machines.

If the price named in the report is the total manufacturing cost of a binder, as the report asserts, why does the Minnesota Prison factory, with prison labor and no interest charge on its investment, sell its binders at from $100 to $110?

In actual pound weight a binder costs the farmer less money than he pays for his cook stove. Prices have been kept down by improved labor-saving machines.

The report endeavors to bring to life that old perennial falsehood, that harvesting machines are being sold abroad cheaper than at home. The reverse has been proved so often it is strange that people continue to talk about it.

No longer ago than 1909 the United States Government, in the Daily Consular Trade Reports, published the results of its own investigations. These showed that the 6-foot binder, for which the American farmer pays approximately $125.00, is sold in France for $173.70; in Germany, $203.00; in Denmark, $167.50; in South Russia, $168.95, and in Great Brittain, $135.16.

The best proof of the **fairness** of International prices is that the stockholders have realized only a very fair rate of interest on the money invested. For eight years the total dividends paid have averaged 5.92 per cent per annum. Most any good business man can get more than 6 per cent out of his investment.

No attempt is being made to intimate that the men who make and sell farm machines are in business for their health. Neither are the men who buy and use the machines, even though farming is regarded as a very healthful occupation. The manufacturers have made money, So have the farmers. And improved machines have helped them to make it. But to take "the aggregate of created wealth," to quote from an editorial in the New York Times, "it is almost incalculably on the side of the farmers."

The International increased its line of farm machines for two reasons—to keep its plants open the year around, and to keep its employes constantly employed.

Without the reaper we would be a stranger to modern progress. Its perfection released two-thirds of our population from the farm for other lines of endeavor, and, along with the full line of farm machines which followed, and scientific methods of cultivation, reduced the labor necessary to raise a bushel of wheat from nearly five days to ten minutes.

EXAMINATION FOR ASSISTANT FOREST RANGERS.

The National Civil Service Commission will hold an examination for Assistant Forest Rangers on October 23 and 24, 1911. The United States Department of Agriculture estimates that 400 eligibles will be needed during the field season of 1912. Assistant Forest Rangers are paid an entrance salary of $1,100 per annum.

The examinations will be held at National Forest headquarters in Alaska, Arizona, Arkansas, California, Colorado, Florida, Idaho, Kansas, Minnesota, Montana, Nebraska, Nevada, New Mexico, Oklahoma, Oregon, South Dakota, Utah, Washington and Wyoming. No examinations will be held in Michigan.

The law requires that when practicable, Forest Rangers must be qualified citizens of the state or territory in which the National Forest on which they are appointed is situated. Since the list of local eligibles must be exhausted before eligibles residing in other states can be appointed, the chance of citizens of outside states who go to the National Forest states and take the examination to secure an appointment is small.

The requirements and duties of Forest Rangers are thus described in "The Use Book," which contains the regulations and instructions for the use of the National Forests:

"A ranger of any grade must be thoroughly sound and able-bodied, capable of enduring hardships and performing severe labor under trying conditions. He must be able to take care of himself and his horse in regions remote from settlement and supplies. He must be able to build trails and cabins, ride, pack, and deal tactfully with all classes of people. He must know something of land surveying, estimating and scaling timber, logging, land laws, mining and the livestock business.

"On some forests the ranger must be a specialist in one or more of these lines of work. Thorough familiarity with the region in which he seeks employment, including its geography and its forest and industrial conditions, is usually demanded; although, lack of this may be supplied by experience in similar regions.

"The examination of applicants is along the practical lines indicated above, and actual demonstration, by performance, is required. Invalids seeking light out-of-door employment need not apply. Experience, not education, is sought, although ability to make simple maps and write intelligent reports upon ordinary forest business is essential.

"For duty in some parts of Arizona and New Mexico the ranger must know enough Spanish to conduct forest business with Mexicans.

"Where saddle horses or pack horses are necessary in the performance of their duty, rangers are required to own and maintain them. The Forest Service furnishes no personal or horse equipment.

"Rangers execute the work of the National Forests under the direction of supervisors. Their duties include patrol to prevent fire and trespass, estimating, surveying and marking timber, the supervision of cuttings and similar work. They issue minor permits, build cabins and trails, oversee grazing business, investigate claims, report on applications, and report upon and arrest for violation of Forest laws and regulations."

The examination is under the control of the Civil Service Commission, and not of the Forest Service. Information in detail regarding it, including the names of the places at which it will be held, will be sent to anyone aplying to the United States Civil Service Commission, Washington, D. C.

IMPORTS OF COTTON INTO THE UNITED STATES.

It seems strange to see the greatest cotton producing country of the world bringing raw cotton half way around the globe and importing it for use in her own manufacturing industries. It is nevertheless a fact that the United States, which produces practically two-thirds of the world's cotton, brought from China during the last fiscal year, (1911) more than 9,000,000 pounds of raw cotton, at a cost in that country of more than $1,000,000, and from India in 1910 about 5,500,000 pounds, at a valuation of more than $500,000. Other distant sections of the world were also drawn upon—Peru, 4,750,000 pounds in 1911; Dutch East Indias, in 1909, nearly 500,000 pounds; Haiti, in 1911, nearly 500,000 pounds, while other contributors include Venezuela, Ecuador, British West Indies, Santo Domingo, Mexico, Panama, Nicaraugua and Costa Rica, while from Egypt, the chief source of supply of long stapled, high grade cotton, the imports in 1911 were larger than in any earlier year, amounting to 88,000,000 pounds. In addition to this there was imported from England about 7,500,000 pounds, presumably chiefly East Indian, Egyptian and West African, since England, of course, produces no cotton. Raw cotton importations in 1911 were larger than in any earlier year, amounting to 113,768,313 pounds, valued at $24,776,320.

High prices of domestic cotton are the cause of the large increase in importation of cotton, especially that from China and India. The quantity of cotton imported from China never reached a quarter of a million pounds prior to 1908, and in 1909 was practically 1,500,000 pounds, in 1910, 4,500,000, and in 1911, 9,000,000 pounds. From India the quantity imported seldom reached 500,000 pounds prior to 1908, in which year the total was over 750,000 pounds; in 1910, 5,500,000, and in 1911, 2,500,000. The Chinese and Indian cottons are as a rule of shorter staple than that of the United States, and as a consequence, are rated at a somewhat lower price in the world's market, a fact which accounts for the large growth in the importation of these cottons in the recent years in which American cotton has commanded exceptionally high prices. On the other hand, Egyptian cotton, which is of longer staple, higher quality, and therefore higher in price than that of the United States, still forms a large proportion of the imports, being 88,000,000 pounds in 1911.

METHODS OF CONSTRUCTION OF WELLS.*

A number of deep wells of larger diameter have also been drilled. Some of these were put down by the railroad company; others were test wells sunk by the State of Utah; and still others were oil prospects sunk by different concerns.

The large dug wells with tunnels or infiltration galleries are a special type adapted to special conditions. They are found chiefly at Eureka and Homansville where it is important to obtain as large supplies as possible from the meager seepage out of the decomposed igneous rock and overlying loose waste.

The wells on the alluvial slopes are, almost without exception, of the dug type, but in some respects drilled wells with iron casings 4 to 6 inches in diameter would be better adapted to the conditions. They could easily be sunk to greater depths than the dug wells and thus they would frequently find water where the dug wells are failures. They would not, like the dug wells, end in the first water-bearing bed encountered, which is generally weak; but could be carried to deeper horizons where large supplies would be found. They would also be better protected from pollution and would therefore furnish cleaner and safer water for drinking and culinary use. If the labor required in digging a well is not considered, a dug well is, of course, much less expensive than a drilled one would be, but if the labor were paid for at a fair wage the dug well would probably not be cheaper. Since the digging is frequently done at times when there is no other work, the actual cost of many of the dug wells is not great. For drilling on the bench lands the light jetting rigs used on the flats would not be adequate, but heavy rigs, such as are used in sinking oil wells, are not necessary. A portable rig with cable and 4-inch or 6-inch percussion drill, built to go to depths of several hundred feet, will be serviceable for this kind of work. Such a machine can be purchased at a moderate price and operated with only moderate expense. If bowlders too large to be pushed aside by the drill are struck it may be possible to shatter them by use of explosives, or, if the drilling has not progressed far, a new hole can be started with no great loss of time.

Wherever irrigation with ground water is undertaken wells of large diameter should be drilled. These wells should be drilled deep enough into the unconsolidated sediments to tap water-wearing beds that have not been reached in ordinary drilling, and they should admit water at as many levels as practical. Since in the localities where the ground water is near the surface the unconsolidated sediments are easily penetrated with a drill, and since rock drilling is not involved, the difficulty of making these larger irrigation wells will not be as great as might be supposed. With the proper type of machine and with some experience in operating it, the work can be done rapidly and with few mishaps. The adoption of better methods than now prevail will lead to lower costs and to larger yields from both flowing and pumped wells, and may make practical the development of ground waters in areas where their development is now impracticable.

The California or "Stovepipe" Method of Well Construction.

In California, where irrigation water is very extensively drawn from unconsolidated valley-fill material similar to that in which most of the valuable Utah ground waters occur, a special type of well has been evolved. In the belief that the California method of well construction can be used with advantage in the valleys of Utah, the following description is quoted from a paper by Charles S. Slichter:

Conditions in California.

The valleys in southern California are filled with deposits of mountain debris, gravels, sand, bowlders, clays, etc., to a depth of several hundred feet, into which a considerable part of the run-off of the mountains sink. The development of irrigation upon these valleys soon became so extensive that it was necessary to supplement more and more the perennial flow of the canyon streams by ground water drawn from wells in the gravels. This necessity was greatly accentuated by a series of dry years, so that the ground waters became a most valuable source of auxiliary supply for irrigation in the important citrus areas in southern California. The type of well that came to the front and developed under these circumstances is locally known as the "stovepipe" well. It seems to suit admirably the conditions prevailing in southern California. In producing water for irrigation the item of cost is, of course, much more strongly emphasized than in obtaining water for municipal use. The drillers of wells in California were not only confronted with a material which is almost everywhere full of bowlders and similar mountain debris, but also by a high cost of labor and of well casings. It was undoubtedly these difficulties that led to the very general adoption in California of the "stovepipe" well.

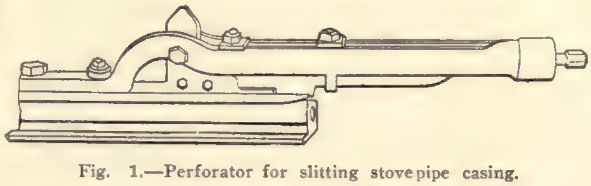

Fig. 1.—Perforator for slitting stovepipe casing.

Description of Apparatus and Methods.

The wells are put down in the gravel and bowlder mountain outwash or other unconsolidated material to any of the depths common in other localities. One string of casing in favorable location has been put down over 1,300 feet. The usual sizes of casings are 7, 10, 12 and 14 inches, or ever larger. A common size is 12 inches. The well casing consists of, first, a riveted sheet-steel "starter," from 15 to 25 feet long, made of two or three thicknesses of No. 10 sheet steel, with a forged steel shoe at lower end. In ground where large bowlders are encountered these starters are made heavier, the shoe 1 inch thick and 12 inches deep, and three-ply instead of two-ply No. 10 sheet-steel body.

The rest of the well casing, above the starter, consists of two thicknesses of No. 12 sheet steel made into diveted lengths, each 2 feet long. One set of sections is made just enough smaller than the other to permit them to telescope together. Each outside section overlaps the inside section 1 foot, so that a smooth surface results both outside and inside of the well when the casing is in place, and so that the break in the joint is always opposite the middle of a 2-foot length. It is these short overlapping sections which are popularly known as "stovepiping."

The casing is sunk by large steam machinery of the usual oil-well type, but with certain very important modifications. In ordinary material the "sand pump" or "sand bucket" is relied upon to loosen and remove the material from the inside of the casing. The casing itself is forced down, length by length, by hydraulic jacks, buried in the ground, and anchored to two timbers 14 by 14 inches and 16 inches long, which are planked over and buried in 9 or 10 feet of soil. These jacks press upon the upper sections of the stovepiping by means of a suitable head. The driller, who stands at the front of the rig, has complete control of the engine, the hydraulic pump, and the valves by which pistons are moved up or down, and also of the lever that controls the two clutches which cause tools to work up and down or to be hoisted.

The sand pumps used are usually large and heavy. For 12-inch work they vary in length from 12 to 16 feet, are 10⅝ inches in diameter, and weigh, with lower half of jars, from 1,100 to 1,400 pounds.

After the well has been forced to the required depth, a cutting knife is lowered into the well and vertical slits are cut in the casing where desired. A record of material encountered in digging the well is kept and the perforations are made opposite such water-bearing materials as may be most advantageously drawn upon. A well 500 feet deep may have 400 feet of screen if circumstances justify it.

The perforator (see fig. 1) for slitting stovepipe casing is handled with 3-inch standard pipe with ¾-inch standard pipe on the inside. In going down or in coming out of

*Abstract of Water Supply Paper No. 277, by Oscar Meinzer, 1911.

the well the weight of the ¾-inch line holds the point of the knife up. When ready to "stick" the ¾-inch line is raised. By raising slowly on the 3-inch line with hydraulic jacks, cuts are made from three-eighths to three-fourths inch wide and from 6 to 12 inches long, according to the material at that particular depth. In another type of perforating apparatus (fig. 2) a revolving cutter punches fine holes at each revolution of the wheel. This style of perforator is called a "rolling knife." Besides these many other kinds of perforators are in use in California. In fact, the perforator is a favorite hobby of the local inventors. They all seem to work well.

Advantages of the California Method.

Among the special advantages in the stovepipe construction we may enumerate the following:

1. The absence of screw joints liable to break and give out.

2. The flush outer surface of the casing, without couplings to catch on bowlders or to hang in clay.

3. The elastic character of the casing, permitting it to adjust itself in direction and otherwise to dangerous stresses, to obstacles, etc.

4. The absence of screen or perforation in any part of the casing when first put down, permitting the easy use of sand pump and the penetration of quicksand, etc., without loss of well.

5. The cheapness of large-size casings, because made of riveted sheet steel.

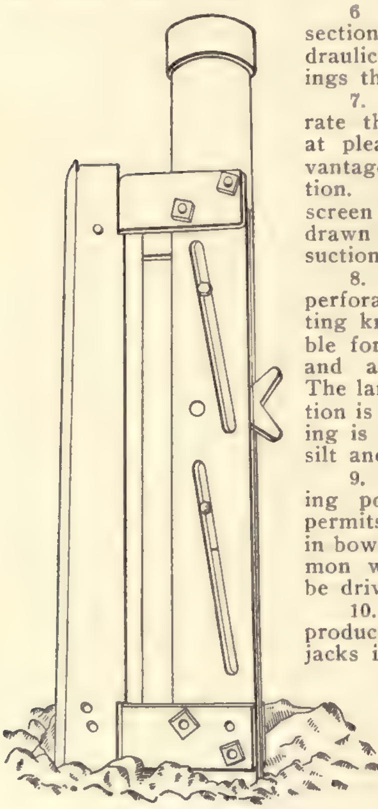

Fig. 2.—Roller type of perforator.

6 The advantage of short sections, permitting use of hydraulic jacks in forcing casings through the ground.

7. The ability to perforate the casing at any level at pleasure is a decided advantage over other construction. Deep wells with much screen may thus be heavily drawn upon with little loss of suction head.

8. The character of the perforations made by the cutting knife are the best possible for the delivery of water and avoidance of clogging. The large side of tthe perforation is inward, so that the casing is not likely to clog with silt and debris.

9. The large size of casing possible in this system permits a well to be put down in bowlder wash where a common well could not possibly be driven.

10. The uniform pressure produced by the hydraulic jacks is a great advantage in safety and in convenience and speed over any system relying upon driving the casing down by a weight or ram.

1. The cost of construction is kept at a minimum by the limited amount of labor required to man the rig, as well as by the good rate of progress possible in what would be considered in many places impossible material to drive in, and by the cheap form of casing.

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Cost of the Wells.

An idea of the cost of constructing these wells can best be given by quoting actual prices on some recent construction in California. According to contracts recently let near Los Angeles, the cost of 12-inch wells was:

Fifty cents per foot for the first 100 feet, and 25 cents additional per foot for each succeeding 50 feet, casing to be furnished by the well owner. This makes the cost of a 500-foot well $700 in addition to casing. The usual type of No. 12 gauge, double stovepipe casing, is about $1.05 a foot, with $40 for 12-foot starter with ¾-inch by 8-inch steel ring. A good driller gets $5 a day; helpers, $2.50 a day. The cost of drilling runs higher than that given above in localities where large and numerous bowlders are encountered.

The drillers build their own rigs according to their own ideas, so that no two rigs are exactly alike; that is, the drilers pick out the casings and working parts and mount them according to ideas that experience has taught them are the best for the wash formations in which they must work. Figure 3 shows a common form of rig.

It is not very profitable to name individual wells of this type and give their flow or yield, since conditions vary so much from place to place. From the method of construction it must be evident that this type of well is designed to give the very maximum yield, as every water-bearing stratum may be drawn upon. The yield from a number of wells in California of average depth of about 250 feet, pumped by centrifugal pumps, varied from about 25 to 150 miners' inches, or from 300.000 to 2,000,000 gallons a day. These are actual measured yields of water supplied for irrigation.

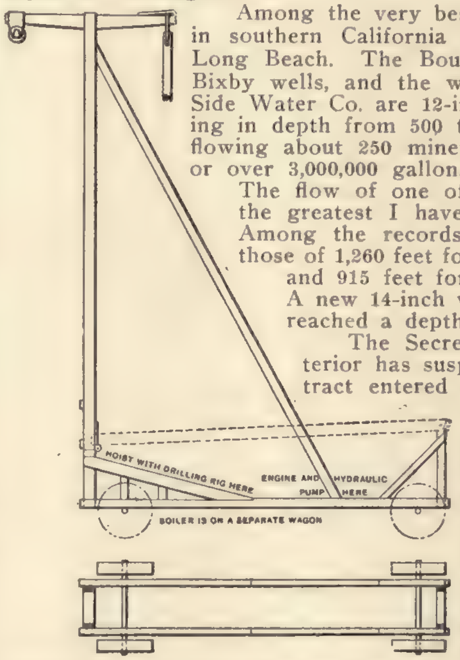

Fig. 3.—Common form of California well rig.

Among the very best flowing wells in southern California are those near Long Beach. The Boughton well, the Bixby wells, and the wells of the Sea Side Water Co. are 12-inch wells, varying in depth from 500 to 700 feet, and flowing about 250 miners' inches each, or over 3,000,000 gallons per 24 hours. The flow of one of these wells is the greatest I have seen reported. Among the records for depth are those of 1,260 feet for a 10-inch well, and 915 feet for a 12-inch well A new 14-inch well has already reached a depth of 704 feet.

The Secretary of the Interior has suspended the contract entered into January 2, 1911, with W. H. Mason of Klamath Falls, Oregon, for the construction of the Lost River division channel, Klamath irrigation project, Oregon-California. This action was taken owing to the evident inability of the contractor to comply with the terms of his agreement, and for the further reason that it is highly essential that the work be completed prior to the beginning of the next irrigation season. The work will be completed by force account.

The Secretary of the Interior is asking for proposals for the construction of about nine miles of canal located on the California side of the Colorado River on the Yuma irrigation project, Arizona. The excavation and placing of about 1,300,000 cubic yards of material is involved. The bids will be opened at the office of the United States Reclamation Service at Yuma on October 12, 1911.

DATA ON IRRIGATION IN CANADA.

Less than a score of years ago big areas of Saskatchewan were spoken of as a continuation of the American desert. No end of land in that province and Southern Alberta could have been purchased for one dollar an acre, but few were willing to exchange even that price for farms in the dryer sections. Since then the irrigator has come along and put another face on the situation. Large companies have secured wide stretches of land and to these they are applying water with a result that land carrying water rights is selling readily at from $20 to upwards of $30 an acre.

The same thing is happening in British Columbia, where extensive valleys lacked only an evenly distributed rainfall to make them ideal for fruit growing. To many of these irrigation is being applied and we find orchard land selling for hundreds of dollars an acre. Whereas in the province east of the Rockies almost all irrigation is applied to field crop culture, in British Columbia fully 90 per cent of the watered land is growing or planted with fruit and vegetables.

When irrigation was first practiced in Western Canada, there was no law regulating the use of water, and he who wished took from the nearest stream what he thought he required, without permission or without making any record of the quantity taken. As settlement advanced the attention of the governing bodies was drawn to the confusion that was certain to result as the practice became more general. In due time, legislative measures were passed at Ottawa and at Victoria, the former to govern the irrigation practice of Alberta and Saskatchewan, while the latter applied to the Pacific province. Several water acts have been enacted in British Columbia, the earlier ones being designed to control the use of water in mining. These were found inadequate for irrigation and in 1909 a more complete measure was passed by the legislature. This consisted really in a consolidation of former acts with some additional provisions. In the earlier acts water was measured in the terms the miner's inch, while the present measure provides for a discharge of one cubic foot of water per second, flowing water, and the acre-foot the unit of measurement of quantity. The miner's inch was one-half the quantity of water passing through as orifice one inch wide, two inches high, under a continuous pressure of seven inches. For purposes of irrigation this measurement is impracticable. The terms of the present act are self-explanatory.

According to the British Columbia Water Act priority of purposes for which licenses should be granted are, 1st, domestis; 2nd, municipal; 3rd, irrigation for agriculture or horticulture; 4th, steam for power; 5th, cold water power except for mining; 6th, mining; 7th, clearing streams for driving logs.

The Dominion Act bearing the title "The Northwest Irrigation Act" controls water rights for irrigation purposes in Saskatchewan and Alberta.

Each applicant for water rights is required to file with the Commissioner of Irrigation a memorial and plans showing clearly the source of water supply, the point of diversion, the character of the proposed works, and the land to be irrigated. He is required to own or control the land to be irrigated, or to enter or submit to the government agreements for the supply of water to lands not owned by him. When it has been satisfactorily established, by actual inspection on the ground, that the project is feasible, not only from the engineering standpoint, but as a commercial proposition, authority is given for the construction of the works, and a date fixed for their completion.

Upon the completion of the works the law requires that they shall be inspected by a competent engineer in the employ of the government. If, after such inspection, the works are found to be constructed in accordance with the plans filed, the Commissioner of Irrigation so certifies and a license is issued authorizing the applicant to divert a sufficient quantity of water, at the rate of one cubic foot per second for each 150 acres, to irrigate the irrigable land shown on his plan. The water then becomes appurtenant to such land, and may not be transferred or used upon any other land without the written consent of the government. The license remains in effect for as long as the works are maintained in good condition and the water is used for the purpose for which it is granted, but provision is made for the cancellation of the license for abandonment or non-use.

While irrigation is applied to many small areas in British Columbia the chief irrigation projects in that province are confined to the valleys of the Okanagan and Thompson rivers with their tributaries, embracing an area of about half a million acres of land. These valleys are located in what is termed the dry belt of British Columbia, but are otherwise admirably adapted for crop growing. To reclaim this vast area, systems, which will water some 100,000 acres, have already been constructed or are under way. So far much of this has been done by private enterprise. Much of this area is already growing alfalfa, vineyards and orchards, and is valued at $20,000,000. The cost of irrigation systems, when completed, will be about $3,000,000.

Apart from the private concerns introducing systems there are two land companies taking up the work. The Central Okanagan and Belgo-Canadian Land Co. and the White Valley and the Okanagan Centre Land Co. have purchased extensive areas of land, and to enhance the value of this they are putting in modern systems, using steel and concrete to a large extent. At Kelowna, in Southern Okanagan, a complete pressure pipe system for both irrigation and domestic water has been installed. This method insures the highest duty for a given unit of water, and will be largely followed elsewhere in British Columbia.

In the provinces of Saskatchewan and Alberta, besides the larger projects under construction by companies there are 390 separate irrigation schemes.

The larger projects being developed are those of the Canadian Pacific Railway Company, the Alberta Railway and Irrigation Company, and the Southern Alberta Land Company. These three concerns control an irrigable area of about 2,000,000 acres of land.

The Canadian Pacific Railway Company's project is the largest of the three. It controls a block of about 3,000,000 acres, extending 150 miles east of the city of Calgary and between the Bow and Red Deer rivers. This company has been given permission to divert sufficient water from the Bow river to irrigate from 450,000 acres at low water to 2,700,000 at flood water.

This company has been given fifteen years from April 21, 1904, within which to complete their works and secure license for the water, but are permitted to use water during construction. Lands are sold at from $15 per acre for non-irrigable to from $25 to $30 per acre for irrigable lands in most parts of the tract now for sale. The irrigable area on each parcel is determined by survey before sale is made. The purchaser agrees to pay to the company 50 cents per acre annually as water rates for the irrigable portion. This contract is perpetual, and the water right is appurtenant to the land sold, and to no other land, and may not be sold, or transferred separately from the land.

The estimated cost of these works is $5,000,000, and the total length of the canal system, including distributing ditches will be in the neighborhood of 2,900 miles.

The Alberta Railway and Irrigation Company is the pioneer company in irrigation in Canada. In 1899 authorization was granted this company to divert water from the St. Mary river and other sources for irrigation purposes. In 1902 rights to additional water were secured and in December of the same year they were permitted to purchase a tract of half a million acres lying to the east of their land grant holdings. They were given a period of fifteen years within which to complete their irrigation system. Their privileges entitle them to 1,600 second feet of water during low water, and 3,500 second feet during high water and flood.

The company at an early date took steps to colonize the lands tributary to their projected ditches. The towns of Raymond, Magrath and Stirling are the direct results of this irrigation enterprise and colonization scheme.

Lands are sold by the company at $5 per acre, without water rights, and from $30 per acre with such rights. An annual charge of $1 per acre is made for water, in addition to the price of the water right sold with the lands. The water rights are apputenant to the lands sold out,

but are not permitted and may be forfeited by non-users for two consecutive years.

Some 231 miles of canals have already been constructed, including 57 miles of natural channel used for the same purpose. The main canal has a capacity of 1,400 cubic feet of water per second. Distribution ditches are not included in the mileage mentioned, as, under this company's system, such ditches are constructed by the water users, the company only building the canals and main laterals. The amount expended by the company on their canal system is about $1,300,000.

The Southern Alberta Land Company has acquired some 400,000 acres between the Bow and Belly rivers and eastward from the junction of these streams towards Medicine Hat. They have been given the right to divert 2,000 cubic feet of water per second from the Bow river, at high water and flood stages only, the low water flow of the stream being already appropriated for other irrigation projects. Consequently enormous storage capacity is having to be provided. The work of constructing ditches, dams and other necessary equipment are well under way and it is expected that water will be turned into the land during the summer of 1912.

Under the terms of agreement, the company is required to irrigate not less than twenty-five per cent of the land purchased, or 95,000 acres. If the quantity of water reserved proves to be greater than the company can apply to beneficial use on lands sold to them, they will be required to dispose of the surplus to any whose lands can be served by these ditches.

LOUISIANA A DESIRABLE PLACE FOR SETTLERS

The state of Louisiana, with many million acres of now uncultivated but highly productive soil, a mild climate which permits a series of crops to be grown on the same land each year, and a network of navigable canals and streams which insures cheap transportation, will bid for the immigration Canada is now getting from the United States. In order to make the bid most effective, a Louisiana Agricultural Exhibit Commission has been appointed by the Governor, and supplied with funds by the parishes or counties of the state, for the purpose of gathering exhibits and data concerning agricultural production, cost and profits, health and market conditions, character of soil and climate, etc., and thus equipped meet the people of the north and west face to face.

The commission will demonstrate that with only about 5,000,000 acres in cultivation out of 27,000,000 acres comprising the state, the people of Louisiana have prospered, her planters have enjoyed wealth and affluence, and her farmers have never known want. The plantation or overlord system is now rapidly disappearing and the great estates are being subdivided and cultivated by smaller independent farmers. The cut-over forests are being cleared and opened up to settlement. The wet alluvial lands are being drained and made available to the plow. In this manner new tracts of virgin lands are being made available and the state in its official capacity is taking time by the forelock and is going after farmer families to occupy these lands.

The first exhibit the Louisiana commission will give will be at the United States Land and Irrigation Exposition at Chicago, November 18 to December 9. Others will follow later. The object of the commission is to exhibit average rather than abnormal products, so that the farmer seeking accurate information may learn exactly what the soils of Louisiana produce under normal conditions.

No land will be sold at these exhibits, no private enterprise will be exploited and no information will be given out except such as have been carefully investigated and compiled by the commission itself. The chairman of the commission, Dr. W. R. Dodson of Baton Rouge, is the dean and director of the State College of Agriculture and Agricultural Experiment Stations.

NEW CORPORATIONS.

The Zimmerman Land & Irrigation Company, of Zimmerman, Pecos County, Texas, has recently filed its charter with the Secretary of State. The company is capitalized at $200,000. The incorporators are Davie Zimmerman, James W. Fogelman and Silas E. Rice.

SILAGE AND CONCRETE SILOS.

The principal source of profit in dairying, stock-raising and farming lies in improving the quality and at the same time keeping down the cost of production. In this matter of profit and loss nothing plays such an important part as the question of feeds and feeding. The natural feed for animals, the one on which they do best, is green pasture. In climates subject to frost, man has made the same provision for animals as for himself by providing them in winter with canned green fodder called "silage." Silage is made most commonly from corn, cowpeas, clover, sorghum, or alfalfa, merely chopped fine and stored in large water-tight cans known as "silos." In dry weather or in winter, when green pasture cannot be had, this feed is equally good in producing a flow of milk or in putting fat on animals. One acre of a crop harvested as silage will feed twice as much stock as the same amount harvested in any other manner.

Like a glass fruit jar, a silo must be water-tight and jointless to keep the silage from moulding or "dry firing." For this reason, and also because no painting or repairing is ever necessary, solid-wall concrete silos are coming into general use.

Selecting the Size of the Silo.

The best silos are built circular in shape. The size depends upon how many animals are to be fed daily, the quantity in pounds for each animal's daily feed, and the number of days it may be necessary to feed them. The silo should be of such size that a layer of silage at least 2 inches in depth will be removed each day after feeding has begun. This prevents a thin top layer from moulding. A dairy cow requires about 40 pounds of silage per day, and the following table is based on this amount. Forty pounds is also the average weight of a cubic foot of silage.

DIMENSIONS OF SILO ACCORDING TO SIZE OF HERD.

Number of Cows in Herd.	Feed for 180 Days.				Feed for 240 Days.			
	Estimated Tonnage of Silage Consumed.	Size of Silo.		Corn Acreage Required at 15 Tons to Acre.	Estimated Tonnage of Silage Consumed.	Size of Silo.		Corn Acreage Required at 15 Tons to Acre.
		Diameter.	Height.			Diameter.	Height.	
	Tons	Ft.	Ft.	Acres	Tons	Ft.	Ft.	Acres
10	36	10	25	2½	48	10	31	3½
12	43	10	28	3	57	10	35	4
15	54	11	29	4	72	11	36	5
20	72	12	32	5	96	12	39	6½
25	90	13	33	6	120	13	40	8
30	108	14	34	7½	144	15	37	10
35	126	15	34	8½	168	16	38	11
40	144	16	35	10	192	17	39	13
45	162	16	37	11	216	18	39	14½
50	180	17	37	12	240	19	39	16
60	216	18	39	14½	288	20	40	19
70	252	19	40	17	336	..	..	..

It is frequently advisable to cut down the average daily ration or to use silage together with other feeds. With this thought in mind, and especially for dry weather feeding in summer, many farmers find it best to build two silos of moderate size instead of one large structure.

Location and Foundation.

Locate the silo where it will be convenient for feeding. Usually it is joined to the barn by means of a chute and passageway with doors. Since the silo and its contents are heavy, it must be built on solid ground. The bottom of the foundation should go below the frost line. The silo may, with advantage, extend 4 to 5 feet into the ground. Dig the pit large enough to allow for the thickness of the circular walls and a footing 2 feet wide.

Making the Forms.

In order to save lumber the concrete is poured into forms which can be moved up as the concrete sets or becomes hard. These movable forms consist of two circular shells 3 to 4 feet high, so made that one fits within the other with space between for a 6-inch wall. The horizontal framework consists of 2 by 4-inch timbers cut to

a circle, which are covered with sheet metal or wooden lagging. Each piece must be long enough to provide for a 6-foot 3-inch length of the circumference of the circle as well as several inches for the lap or strap joints. The forms are raised by loosening them at the joints and setting them up again on the finished section of the silo.

Mixing and Placing the Concrete.

Concrete for silos should be rich in Portland cement and should be put into the forms mushy wet. Mix it 1 part cement to 2 parts sand to 4 parts crushed rock. Four parts of clean pit or bank-run gravel may be used instead of the sand and rock. Measure all materials on the basis that 1 bag of cement equals 1 cubic foot. Many persons raise the concrete in buckets, but the work can be done more quickly and easily by using a horse, together with a derrick or a well braced jib-boom fixed to an adjoining building.

Building the Silo.

The finished silo shown above is 15 feet in diameter (inside) and 36 feet high, of which 4 feet is below ground. At odd times all of the materials were hauled, so that there would be no delay when the work was started. After the pit was dug to solid clay, the concrete footings (2 feet wide and 1 foot thick) were placed, and a 4-inch concrete floor was laid upon the natural clay bottom. The next day the forms were set up, the reinforcement placed, and the walls begun. These forms were 4 feet high and were made in eight sections 6 feet 3 inches long.

Since silage contains so much water, steel rods are necessary as reinforcement to withstand the pressure. To get the best results, this reinforcing should be placed exactly 1½ inches from the outside of the silo wall. Rods ⅜-inch in diameter and 10 feet long were used. The vertical rods were spaced 18 inches apart. Measuring down from the top of the silo, the horizontal rods were spaced as shown in the tables below.

Spacing of Horizontal Reinforcement.

Feet distant from top	40-35	35-30	30-25	25-20	20-15	15-10	10-0
Spacing in inches	6	7	8	10	12	15	18

The horizontal rods were carefully made into solid hoops by bending the ends so as to hook together. They were also wired to the inside of the vertical rods. (Complete plans for silos may be obtained free from any Portland cement company.) Two extra lengths were placed in the concrete 1½ inches above the door openings for removing the silage. These openings were made by a removable form (also cut to the circle), which fitted snugly between the molds for the silo wall.

The silo forms were filled with concrete and allowed to stand over night. The next morning they were loosened, raised and again filled. These operations were repeated daily until the side walls were finished.

With a 4-inch concrete roof, the silo is entirely fire- and repair-proof. The roof was built on a temporary wooden roof, which was entirely removed after three weeks. The concrete roof is cone-shaped with a rise in the center of 2 feet and a drip or overhang of 1 foot. One inch from the under side, this roof is reinforced with ¾-inch rods laid like the spokes of a wheel and spaced 18 inches at the rim. Every other rod reached only half-way to the peak of the roof. To hold the spokes in position so that the concrete could be forced between them and the temporary wooden roof, one ring of ⅜-inch rods was wired to this reinforcing just over the side walls and another half-way to the peak. These rods strengthen the roof greatly and must not be left out. Water-soaked weather boards were used to form the circular edge of the roof. An opening for the blower tube from the cutter was formed in the silo roof in the same manner as the doors in the side walls.

The Cost of Concrete Silos.

The list of materials required for this silo is given below together with a very liberal estimate of the cost of the same. The silo was built by five farm laborers in thirteen days. As a raise was made each day, the four extra days were spent in framing the forms, digging the pit and building the roof. The owner used gravel from his own farm pit instead of stone and sand.

BILL OF MATERIALS.

Crushed rock, or screened gravel	40 cu. yds. at $1.10	$ 44.00
Sand	20 cu. yds. at $1.00	20.00
Portland cement	54 barrels at $2.50	135.00
Reinforcing, 425 pieces of ⅜-inch x 10-foot rods	1564 pounds at $0.02¼	39.10
		$238.10

The first cost of concrete silos may or may not be greater than that of the best of any other kind. The time is now at hand when farmers, like railroads and corporations, are considering the lasting qualities of buildings. Concrete silos need no insurance; they do not blow down or burn up. They never have to be painted or repaired. With other kinds of silos during their short lives, these expenses alone equal the first cost. Concrete lasts forever.

The two cuts shown herewith give a good idea of the work.

OUR UNDERGROUND WATERS.

Water is found in some amount in all formations below the earth's surface, from the loosest and most porous sands and gravels to the hardest slate and granite. The amount varies from the merest trace chemically combined in the molecules of the rocks to immense reservoirs which supply wells flowing hundreds of thousands of gallons a day. Some waters are so pure that a refined chemical analysis shows only minute traces of organic and mineral matter; others are so heavily charged with minerals or other impurities as to be unsuitable for use.

The slope of the surface at any point is one factor determining the amount of water absorbed by the ground. The direction and amount of slope also determine the form of the water table that is, of the upper limit of saturation. Except where the surface is flat the water table is generally not parallel with the surface; it is almost invariably farthest from the surface on the summits of hills and mountains and nearest to it in valleys and along the coast, reaching the surface in swamps and along rivers, lakes, and beaches. The surface of the water table is always in motion, its higher portions flowing toward the lowest outlets along rivers or the sea. This direction of flow explains why fresh water is usually found when a well is dug in a sandy beach.—From Water-Supply Paper 223, United States Geological Survey.

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THE INFLUENCE OF THE IRRIGATION CONGRESS IN THE DEVELOPMENT OF THE WEST.*

The Nineteenth National Irrigation Congress, which is to be held in Chicago December 5-9 of this year, promises to be the most important meeting of this body ever held. For twenty years the Irrigation Congress has been the most potent influence in the development of the West. Steady of purpose and unselfish, its efforts have always been devoted to the welfare and development of the western portion of the United States. Incidentally, other sections have profited by the discussions of these congresses and agriculture the world over has benefited.

The passing of the Reclamation Act and the subsequent expenditure of more than sixty millions of dollars by the government in the reclamation of arid lands is due more to the influence of the National Irrigation Congress than to any other one agency.

In coming to Chicago for the nineteenth meeting, it was the thought of the delegates to the Congress in Pueblo last September that here was a great opportunity for a missionary campaign, that coming to one of the great commercial centers of the country an opportunity would be given to the people of the East and South to learn of the objects of this Congress and what could be accomplished by its efforts. It is quite probable that one of the most important subjects considered at this Congress will be the extension of the reclamation act to cover the drainage of the swamp lands of the South and the East. In the United States there are from seventy to eighty million acres of these swamp lands, and on account of their location and physical conditions, it is impossible for satisfactory reclamation to be undertaken by district, county or state and necessarily this work must be done by the Federal government. The attorneys of the government in Washington believe that the execution of the provision of the reclamation act has established precedents which would warrant the reclamation of these swamp lands under somewhat similar enactments of Congress, and were this done hundreds of millions of dollars would be added to the wealth of the country and most substantial progress made toward the proper reclamation and conservation of our natural resources, for the questions of forestry, deep waterways, prevention of flood and low water periods and general reclamation of arid and swamp lands relate so closely to one another that a general consideration of all of these questions is the only satisfactory way by which these great national problems can be solved, and it is hoped and believed that this meeting of the Irrigation Congress of December 5-9 of this year will give an effective impetus to the solution of this question.

Edmund T. Perkins, Chairman Committee on Publicity, Board of Control, National Irrigation Congress.

The Acting Secretary of the Interior has approved the award of contract to Nelson Rich, of Prosser, Washington, for the construction of Pablo dams and canals, Flathead irrigation project, Montana. Three dams and 8½ miles of canals are included in the contract, involving the placing of about 234,000 cubic yards of earth embankment in the dams and the excavation of about 200,000 cubic yards of material from the canals. The work is located from 2 to 3 miles south of Polson, Montana. The contract price is $115,693 for class "A" material, or $116,093 for class "B."

The Secretary of the Interior is asking for proposals for the construction of about nine miles of canal located on the California side of the Colorado River on the Yuma irrigation project, Arizona. The excavation and placing of about 1,300,000 cubic yards of material is involved. The bids will be opened at the office of the United States Reclamation Service at Yuma on October 12, 1911.

*By Edmund T. Perkins, chairman, Committee on Publicity, Board of Control, National Irrigation Congress.

ENORMOUS DEVELOPMENT WORK.

It is a long time since there has been as much development work going forward on one line of railroad as is now seen along the new Puget Sound route, a part of the Chicago, Milwaukee & St. Paul system. There are important sections of both the Dakotas, Montana, Idaho and Washington which have never had railroad facilities until they were supplied by the Puget Sound line. The region thus affected is larger than all of New England, and it is a land of great attractions and the largest possibilities, capable of sustaining millions of inhabitants.

Since the new Puget Sound line became a reality, four or five years ago, settlers have been going in fast, taking up available land or engaging in business. The innumerable new towns between the Missouri River and Puget Sound afford an endless variety of good openings. There is plenty of cheap land along the route also. In fact, there is still a great deal of government land to be secured as homesteads in the states named, much of it convenient to the railroad. One has only to think of the enormous expanse of territory embraced by the new Puget Sound road to comprehend the extent of the development work now going forward.

The birth of towns, the breaking up of virgin prairie land, the development of market facilities, the hustling incident to the making of new homes and the adjustment of family life to untried social conditions form a situation which is unique and peculiarly American. This kind of thing is made attractive by the energy and adaptability of American men and women. When such a scene is set in the magnificent prairies and plateaus of the Dakotas and their sister states to the west, it becomes a sight well worth visiting.

For tourists and the general traveling public a situation replete with interest has developed. It is abundantly worth while to go out over the new line just to see the amazing things which the settlers are doing, but still more is it wise to get a permanent financial connection in a locality, where the rapid development affords large and quick returns on investments. There are attractions for travelers all the way from Chicago to Puget Sound, and the trip is made in the finest of modern trains.

USE OF ODD LENGTHS IN TIMBER.

The investigation carried on last year by the United States Department of Agriculture, cooperating with lumber manufacturers in the South, to determine the saving that can be effected by using odd lengths of lumber as well as even, has begun to bear fruit. That investigation showed that a material saving was practicable, and at a recent meeting of a southern lumber manufacturers' association the fact was brought out that a beginning has been made in putting the new plan into practice, and that an increase in the sale of odd lengths is anticipated for the near future.

It was formerly the custom, and generally is so still, to sell lumber in even lengths only. Waste resulted from cutting off ends of odd lengths to make them even. A considerable percentage of a sawmill's output is defective. That is, boards have had knots, decayed spots, or split ends, and the defective parts are cut out. To make an even length of what remains, it is often necessary to cut off a foot of good wood with the bad, and it is wasted. The practice of marketing odd lengths as well as even is meant to lessen this waste. The sale of odd lengths of lumber will frequently lessen waste in the woods also; for example, a log may be cut fifteen feet long, which, following the old custom, would be cut only fourteen, and the extra foot would be left in the woods.

The introduction of odd lengths meets with opposition from many builders who are prejudiced in favor of even lengths simply because they have never used any other kind. Nevertheless, there are many places in which odd lengths are more economical than even ones—for instance, where nine-foot studding is used. Following former custom, the ends must be cut from even lengths to make the timbers fit. Some manufacturers of flooring successfully sell odd and even lengths, thus lessening waste in the woods, at the mill, and in the construction of buildings.

RECLAMATION ORGANIZATION.

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BRIG. GEN. WILLIAM L. MARSHALL, U. S. A., retired consulting engineer to the Secretary of the Interior.

FREDERICK HAYNES NEWELL, Director of the Reclamation Service, Washington, D. C.

ARTHUR POWELL DAVIS, chief engineer, Washington, D. C.

PHILIP P. WELLS, chief law officer, Washington, D. C.

MORRIS BIEN, supervising engineer, in charge land and legal division, Washington, D. C.

O. H. ENSIGN, chief electrical engineer, 605 Federal Building, Los Angeles, Cal.

D. W. Murphy, engineer, in charge of Washington office engineering, Washington, D. C.

D. C. Henny, consulting engineer, 605 Spalding Building, Portland, Ore.

A. J. Wiley, consulting engineer, Boise, Idaho.

W. H. Sanders, consulting engineer, 915 Grand View Avenue, Los Angeles, Cal.

J. H. Quinton, consulting engineer, 605 Wright and Callender Building, Los Angeles, Cal.

W. H. Code, chief engineer, Indian irrigation, consultation on Indian matters, 526 Federal Building, Los Angeles, Cal.

W. W. Follett, consulting engineer, International (Water) Boundary Commission, consultation on Rio Grande, El Paso, Tex.

S. W. Dick, transportation agent, 777 Federal Building, Chicago, Ill.

C. J. Blanchard, statistician, Washington, D. C.

E. C. Bebb, engineer, Washington, D. C.

J. Y. Jewett, cement expert, 408 Commonwealth Building, Denver, Colo.

E. G. Paul, chief clerk, Washington, D. C.

V. G. Croissant, accountant, Washington, D. C.

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NATIONAL DAIRY SHOW.

Important action was taken at this month's meeting of the Board of Directors of the National Dairy Show. Plans for leading features of the approaching show (Chicago, October 26th to November 4th) were approved and methods to round out the exhibition were discussed.

Premiums for Brown Swiss and Dutch Belted cattle were each increased twenty per cent, and there was added to the classification a Breeder's Cow Herd, open to the best ten cows two years old or over. This is open to all breeds, and will bring the best specimens of each breed against each other. Cows entering this contest must be bred, but not necessarily owned by exhibitors, who will receive a thousand-dollar trophy and cash prizes of $250 and $100.

There will be on exhibition a model dairy barn, and this with the Government's elaborate photographic trips through leading dairy districts, will round out the agricultural architecture so that the National this year will have the best exhibit in this line ever before attempted.

A committee was apopinted to devise a plan by which there may be gathered the leading cows of the country now on authenticated yearly test. Satisfactory progress has been reported in assembling this great working herd, which will prove the best example of dairy type and conformation ever witnessed in this country.

THE PRIMER OF HYDRAULICS*

By FREDERICK A. SMITH, C. E.

5. *The Circular Form.*

Fig. 79 shows the circular form of conduit and while it is a form in very extended use and is easily applied and figured when flowing either half full or full it is very difficult and tedious to determine the hydraulic radius and conditions of flow when the channel flows neither full nor half full. This difficulty becomes apparent if we consider a random height of flow as indicated by the line AB in Fig. 79. If the cylinder is just full, or just half full, it is easy to determine the wetted perimeter and area, and consequently the hydraulic radius, in the first case, the full area is divided by full circumference, and, in the second case, it is half area of circle divided by half the circumference. In either case $r = d \div 4$ if d is diameter of circle; this is easily proven, for the area of circle $= \pi d^2 \div 4$ and the circumference $= \pi d$, hence $r = (\pi d^2 \div 4) \div \pi d$.

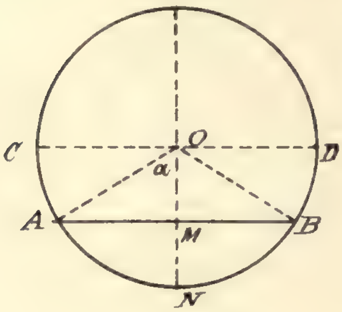


Fig. 79

Cancelling πd we retain:

$r = d \div 4$.

In the case of the semicircle we have: Area $\div \pi d^2 \div 8$; circumference $\pi d \div 2$; hence $r = (\pi d^2 \div 8) \div (\pi d \div 2) = d \div 4$.

Assume a typical case, taking the surface of fluid at AB with a certain distance below the center; here, if the versed sine MN is given, it will be quite a little problem to determine the area of the segment ANB; it requires still more figuring to get the length of the wetted perimeter ANB; thus, if $d =$ diameter of circle and $m =$ versed sine, then $OM = d/2 - m$ and $\cos \alpha = (d/2 - m) \div d/2$; this gives the center angle of the sector, as angle $AOB = 2\alpha$ and area of segment ANB can be found by subtracting triangle AOB from sector $OANB$, thus:

Area of sector: $\dfrac{\pi d^2 \alpha}{4 \times 360}$

Area of triangle: $AM \times OM$

$AM = d/2 \sin \alpha$ and $OM = \dfrac{d}{2} - m$, hence area of triangle $= \dfrac{d}{2} \sin \alpha \left(\dfrac{d}{2} - m\right)$ and flow area $a = \dfrac{\pi d^2 \alpha}{4 \times 360} - \dfrac{d}{2} \sin \alpha \left(\dfrac{d}{2} - m\right)$.

The circumference or wetted perimeter is found:

$p = \pi d \alpha \div 360$.

Divide a by p gives r, but it is seen that it requires considerable figuring.

Certain problems in hydraulics require many trial assumptions before a satisfactory solution is reached which multiply the work many fold. This the author has sought to avoid by the calculation of a number of tables which are embodied in this book.

The value of r grows with the depth or flow or the versed sine from zero to a maximum when m (the versed sine) equals $.813d$; hence the velocity of flow in a circular channel is greatest when .813 full; the quantity Q, however, is greatest when $m = .949d$, when the product of flow area times velocity reaches a maximum.

6. *Summary Comparisons.*

Summarizing the foregoing deductions may be stated the following facts:

1. For open channels where there is considerable variations in the volume of flow and where the best velocity is desired for small flow the triangular section is best.
2. For open channels of nearly constant flow the trapezoidal section is best, providing height of flow is equal to or greater than width of channel at bottom.
3. For closed channels flowing full or under pressure the cylindrical section is best.

7. *A New Form of Channel.*

For sewers or other channels which have to accommodate a small dry weather flow and a considerable flow of storm water at times a combination section is suggested as indicated in Fig. 80; the lower part being formed by two planes forming a right angle with each other and the upper part being a part of a circle. Let it be a horizontal plane passing through vertex A, then angle α should be 45° and angle $BAD = 90°$. The size of such a sewer would be governed by the radius of the cylindrical part, as $AB = BC$.

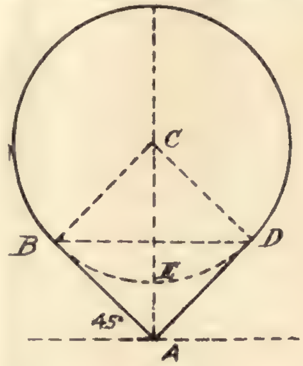


Fig. 80.

Let $R =$ radius, then area will be:

$$a = \frac{3\pi R^2}{4} + R^2; \quad a = \frac{3\pi R^2 + 4R^2}{4}$$

$$a = \frac{R^2}{4}\,((3\pi + 4); \quad a = 3.3562R^2.$$

The wetted perimeter flowing full is $p = \dfrac{2\pi R \times 3}{4} + 2R$.

Simplifying this expression we get:

$$p = \frac{6\pi R + 8R}{4} = \frac{R}{4}(6\pi + 8)$$

$p = 6.7124R$.

Hence: $r = a \div p$: substitute values:

$r = 3.3562R^2 \div 6.7124R$.

$r = R \div 2$.

From this it appears that the hydraulic radius for this combination section is precisely equal to that of the full circle. Consequently when flowing full it develops the same velocity as would be done in a true circle, but its capacity is increased in the ratio of 3.3562 to 3.1416. The main advantage in this shape of a sewer or conduit is the better flow condition it affords in dry weather, when the volume of flow may be as low as one-twelfth of the maximum capacity. The sewer is deeper by EA than the circular sewer,

$CA = \sqrt{2R^2} = R\sqrt{2}$ and since $CE = R$

$AE = R\sqrt{2} - R = R(\sqrt{2} - 1)$

$AE = .4142R$.

This makes total height of sewer $2.414R$, as against $2R$ for true circle.

This form should prove far more desirable than an elliptical shape, and with the general adaptability of concrete construction now-a-days should be easily built; it will be referred to later in order to show its superiority over other forms of sewers.

Article X. The Coefficient of Roughness.

In the determination of the factor C in Kutter's formula all the quantities entering into consideration are definite and fixed, except the coefficient of roughness n. It is therefore quite important that this value n be properly selected. The quantity n should represent everything which acts as resistance to the flow of water. Many thousands of gaugings have been made to determine the value of n in different kinds of channels, and the results obtained are sufficient to act as a guide in the selection of the proper factor for any proposed channel. Some gaugings made show n as low as as .007 and as high as .050, so that all variations in conditions are covered by this amplitude. In ordinary practice n as low as .007 is impracticable and this book begins with $n = .009$ as the lowest coefficient of resistance, which applies only to the smoothest glass pipe or polished metal pipes, perfectly straight and uniform.

Channels to be grouped under $n = .010$:

Glass pipe, lead pipe, tin pipe, straight and regular; wrought iron pipe, galvanized pipe, straight and regular; very hard wood, surfaced, straight and regular.

$n = .011$:

Cast iron pipe (new), neat cement channel, straight and regular; glazed tiling; very smooth planed plank channels of uniform section.

$n = .012$:

Used cast iron pipe, channels formed of two-thirds cement and one-third fine sand, planed boards in flumes of regular section.

$n = .013$:

Very smooth brick work plastered with cement, planed common boards of slightly varying cross-section, hard brick, smooth surface with clean joints, concrete channels, very regular and smoothly plastered.

$n = .014$:

Channels formed of regular masonry, regular brick work with slight variations in cross-section straight line, concrete channels fairly smooth or fairly well plastered.

$n = .015$:

Rough brick work, Ashlar masonry channels, small irregularities in cross-section and line; also channels of very rough concrete.

$n = .017$:

Channels of very rough brick work, or very rough masonry, very good ditches of uniform cross-section and smooth, paved channels.

$n = .020$:

Channels and rivers with paved banks and bed of fine sand (Ohio river, Point Pleasant, .021), ditches cut fairly smooth and uniform.

$n = .025$:

River beds, side walls of good Rubble masonry, channels of fair line and fairly regular cross-section, ditches of irregular section, (not too much so), with some small detritus or light growth of aquatic plants.

$n = .030$:

River bed with embankment walls, detritus in small quantities, pebbles and small boulders in bed, channels and ditches of irregular outline and grade channels with heavy growth of aquatic plants.

$n = .035$:

Channels, rivers and ditches with irregular bed and irregular side walls, boulders, heavy detritus, great variation in the slope and cross-sections.

$n = .040$:

Rivers, canals and ditches with irregular beds, coarse detritus, irregular cross-section, irregular slopes.

$n = .050$:

Rivers of very irregular beds, very coarse detritus, very irregular cross-section with large obstructions and very steep grades.

It is to be understood that the character of a channel has a great deal to do with the flow of water and it may be that the flow conditions of one kind of cast iron pipe may be covered by $n = .010$, while another may require $n = .012$. Similar variations must be looked for in brick, mason and concrete work, and the observant hydraulic engineer or irrigator must judge for himself what coefficient will be suited best for his particular work. Here is where enters the personal equation of the practical side, which cannot be covered in the book, but which each engineer must solve for himself. The foregoing list of different materials and channels are cited merely for an approximate guide.

Article XI. How to Calculate "n".

It is evidently of importance to be able to compute the coefficient n for any case where proper gaugings and observations have been made so as to define more clearly the different degrees of roughness. By an intricate transmutation of the general formula for C, given in the beginning of this article, the quantity n may be developed, and here follows the formula which results:

$$n = \sqrt{\frac{1.811\sqrt{r}}{BC} + \frac{r}{4}\left(\frac{C-B}{BC}\right)^2} - \frac{\sqrt{r}}{2}\left(\frac{C-B}{BC}\right)$$

In this formula r is the hydraulic radius

$s =$ slope

$$B = 41.6 + \frac{.00281}{s}$$

$C = v \div \sqrt{rs}$

$v =$ mean velocity.

Following is an application of this formula, illustrated upon a practical problem: A brick conduit 4 feet in diameter is flowing full; the sine of slope $= .0004$ and the observed mean velocity $= 2$ feet; find n.

Solution. $r = 1$ and $\sqrt{r} = 1$; $\sqrt{s} = .02$; hence:
$C = 2 \div .02 = 100$.
$B = 41.6 + .00281 \div 0004 = 41.6 + 7.02 = 48.62$.

Substitute these quantities in above equation:

$$n = \sqrt{\frac{1.811 \times 1}{48.62 \times 100} + \frac{1}{4}\left(\frac{100-48.62}{4862}\right)^2} - \frac{1}{2}\left(\frac{100-48.62}{4862}\right)$$

Executing operations:

$n = \sqrt{1.811 \div 4862 + \frac{1}{4}(.01056)^2} - \frac{1}{2}(.01056)$

$n = \sqrt{.000376 + .0000279} - .00528$

$n = \sqrt{.0004039} - .00528$

$n = .0201 - .00528 = .0148$.

In this case take $n = .015$.

By the aid of the tables prepared by the author which are embodied in this work this cumbersome operation could have been avoided in the following manner: Since r, v and s are given, C is obtained from the formula $v = C\sqrt{rs}$, from which we first obtain: $C = v \div \sqrt{rs}$. This operation executed in the case under consideration gives $C = 100$.

Now look through the different tables for the place when C is nearest to 100, when $\sqrt{r} = 1$, and for slope .0004. The table for $n = .013$ shows $C = 119.25$ and the table for $n = .015$ shows $C = 97.96$; thus it is seen that the coefficient of roughness should be .015. If absolute accuracy is wanted it may be found by interpolation; thus the coefficient n will be less than .015 and more than .013, in the same ratio as 100 lies between 97.96 and 119.25; difference between these two numbers is 21.29; hence as C decreases 21.29, n advanced from .013 to .015, or at the rate of .0001 per unit; as 97.96 is nearly equal to 98, multiply this by 2 and subtract from $.015 = .0148$, which is the number as found above.

Hence the determination of the coefficient n is quite readily done by the use of the tables with very little work.

Article XII.. Explanation of the "C" Tables.

This book contains 13 tables giving the factor C for 13 different degrees of roughness and for 29 different hydraulic radii, each for six different slopes. These were carefully selected for the purpose of providing sufficient data for all practical problems which might present themselves.

The author made the computations for the square root of the hydraulic radii ($\sqrt{r}$), which still further increases the range of the tables, so that they cover pipes from ½-inch diameter to conduits of 3,600 ft. diameter or rivers or canals of equivalent cross-section. The slopes shown vary from .001 to .000025, which covers practically all cases ever arising.

With these tables calculated ready for use, the solution of hydraulic problems becomes an easy matter, especially if use is made of the tables of hydraulic radii, wetted perimeters, areas of circular segments, and the many other original auxiliary tables, such as square roots, cube roots, etc.

A DAM THAT SEEMS IN DEMAND.

The Ambursen Hydraulic Construction Co. reports a contract with the Auglaize Construction Co. for the construction of Development No. 1 on the Auglaize River near Defiance, Ohio,. The dam is 28 feet high and the total length of the concrete structure, including the power house, is 555 feet.

The Ambursen type of dam has been adopted by the War Department of the U. S. government for the dam which they are about to build across the Mississippi River between Minneapolis and St. Paul. As the dam will be built directly by the government on force account, the contract with the Ambursen company takes the form of an adequate royalty.

The Ambursen Co. is also building two dams for the Department of Irrigation in Porto Rico. One on the Jacaguas River near Guayabal is 115 feet high and 1,200 feet long, and the other on the Coamo River is 62 feet high and 600 feet long. These two, in connection with the 125-foot dam for the Porto Rico Railways Co., near San Juan, makes three heavy pieces of work now under construction in Porto Rico bv the Ambursen Company. The plans for still a fourth dam are now in preparation.

CORRESPONDENCE

WANTS INFORMATION.

Stevensville, Mont., September 24, 1911.

THE IRRIGATION AGE, Chicago, Ill.:

As you seem to be assailed with all kinds of queries and troubles I take the liberty to address you, thinking the editors or some reader of the AGE may have had some experience or have some suggestion to offer in regard to the trouble I will attempt to describe.

The writer is connected with a large irrigation company, which owns and operates a large canal about eighty miles long. In the course of this length there are seven inverted syphons and in each inlet we are forced to maintain an iron grate, to catch small trash which gathers, as this trash will not pass through until it becomes waterlogged.

As the ground along the canal is wild land and a portion still unworked, the banks and the unused land grow quite a crop of tumble weeds.

Now when they break off in the fall and the wind is blowing toward the canal they get in the canal and clog the grates and require diligent watching that they do not back the water up and endanger the banks.

Now, what I would like to ask is this, is there any automatic device for removing the weeds or can any one offer a suggestion as to how one could be made.

Thanking in advance for any favors or suggestions.

Very truly yours.

WM. R. KINDER, C. E.

Can any one of our readers who has had experience in this direction give Mr. Kinder the benefit of such experience?

The Editor suggests the planting of shrubbery along both sides of the canal to catch the blowing tumble weeds. Still it would require the attention of some one to look after the screens.

A BULLETIN FULL OF USEFUL INFORMATION.

IRRIGATION AGE, Chicago, Ill.:

I am sending you under separate cover a copy of Bulletin No. 425 of the University of Wisconsin on the "Flow of Streams and the Factors that Control It, with Special Reference to Wisconsin Conditions." In this bulletin I have discussed in some detail, the principles that govern stream flow, and have endeavored to show as clearly as possible, by actual examples, the results due to known conditions.

One of the most important investigations has been the study of the actual relation of Rainfall to Streamflow on several Wisconsin rivers for a considerable period, in order to determine if such relation has been modified by other progressive causes such as deforestation, cultivation, etc. I have endeavored to make the investigation purely scientific and without prejudice, and have shown all facts found regardless of results.

Please note that the conclusions are drawn for Wisconsin conditions only. These conclusions are believed to be conservative but the facts are presented from which any reader can draw his own conclusions.

Very respectfully yours,

D. W. MEAD.

[The Bulletin referred to above is a valuable addition to hydraulic information and should prove exceedingly useful for all hydraulic engineers and irrigators especially in states wherein obtain Wisconsin conditions.—EDITOR.]

GOOD CROPS IN MONTANA.

That fully 1,000,000 bushels of winter wheat will be threshed from the crop now being harvested on land above the ditch in Yellowstone county alone is the opinion of E. A. Wilson, assistant agricultural agent of the Great Northern Railway company, who is in the city. Mr. Wilson is agricultural inspector for the company of the various demonstration farms along the main line in the northern part of the state, of those at Broadview and near Billings, and of those along the system in North Dakota.

He has been over the districts in this locality thoroughly during the last few days and as a result is enthusiastic over the outlook.

He reports that the cutting of winter wheat immediately adjacent to the city started several days ago and that the harvest around Broadview is well under way.

"The yield will undoubtedly be the largest on record," said Mr. Wilson, "and in my opinion it will range from 20 to 35 bushels to the acre, with a total of about 1,000,000. Local estimates are somewhat higher; in fact, at Broadview it is believed that the returns will, in that one district, be fully 750,000 bushels."

Regarding flax, he says it is in fine condition and that the best fields will show the exceptional return of 20 bushels to the acre, while the general average will be about 15 bushels. Incidentally, Mr. Wilson says that 10 bushels per acre at $1.75 is profitable and that Montana growers of this crop are fortunate with the prospect of at least 15 bushels, with a probable price of $2.50.

So far as oats, durum wheat and other springs crops are concerned, all are looking well throughout the entire district tributary to this city and there is every indication of immense yields and the promise of great prosperity to the growers. H. M. BRAYTON.

CO-OPERATIVE WORK IN IRRIGATION.

For years we have desired investigational work in irrigation, practical work that will help the irrigator in the field, and attempts have been made from time to time to do work along this line. Funds have, however, been short and the work is so expensive that it has been necessary to put off until tomorrow what could not be done today.

Now, however, a change has taken place. The last Colorado legislature appropriated $10,000 for experimental work in irrigation and drainage. This was later cut by Governor Shafroth, together with other appropriations, to $5,000, in order to bring it within the revenue of the state.

In order to make the work as broad as possible a meeting was held in Denver, June 21, with Prof. Samuel Fortier, head of the Irrigation Division of the U. S. Bureau of Experiment Stations, and Dr. A. C. True, U. S. Director of Experiment Stations; the president of the Agricultural College, members of the State Board of Agriculture, and representatives from the Irrigation Engineering department of the college. It was there decided that the U. S. government and the state of Colorado should co-operate in the irrigational work for Colorado and a contract was signed whereby each party agrees to pay the sum of $5,800 for this work.

With an expenditure of practically $12,000 surely some interesting and profitable work should be done. The work has been started and is progressing nicely. Although it was a little late in the season to do much field work this summer we shall be ready and on the grounds when next year's irrigation season opens.

This work will include the application of water to crops by different methods, showing the advantages of one system over another.

The best time to irrigate crops on different soils and how much water to apply is another problem.

Irrigation pumping plants of Colorado will come in for their share of the work. The study of different factors affecting the flow of water in ditches, head works, and weirs, will also be taken up.

It is to be hoped that the work just started will be carried on for years and that many of the irrigation problems may be solved which will bring dollars into the pockets of the Colorado farmer and be a great benefit to the state of Colorado. E. B. HOUSE,

Colorado Agricultural College, Fort Collins.

The primer of hydraulics will be completed about January 1, 1912. If you order a copy of this splendid book with your subscription for THE IRRIGATION AGE, you can save 50 cents; three dollars for the book and the paper for one year.

POSSIBILITIES OF COLORADO RIVER.

Though Supervising Engineer L. C. Hill of the service has never posed as an author he has in mind the preparation of a volume at an early day, for which there will undoubtedly be a great demand, at least in official quarters, and among all who are interested in keeping apace with the industrial development of the country. Mr. Hill's project is not in pursuance of literary fame for his book will probably be an official document with the United States as his publishing agent. The subject of it will be the irrigation and power possibilities of the Colorado River, though that may not be the wording of its title. The size of the volume cannot now be stated, but naturally it will be no mere leaflet for the subject it to big to deal with in a brief paper.

The preparation of such a volume has never until recently been possible, on lines as comprehensive as he desires to write, but he things that there is at present available an ample number of maps, rainfall and run-off reports from the Coolraao watershed, reports from gaging stations, surveys and other data, to deal with the subject quite thoroughly and he will begin the assembling of data at once, expecting to undertake the work as soon as he returns from his present trip around the circle, visiting the projects under his direction and conferring with the supervising engineers and the Secretary of the Interior.

Speaking approximately and without data Mr. Hill says the Colorado River, properly utilized, will furnish water for about 2,000,000 acres of land, below the Grand Canyon of the Colorado, to say nothing of smaller tracts that may be watered in the mountain regions above the canyon. Of this about a half million acres lie in Mexico, but from an industrial viewpoint this country is but slightly less interested in the watering of that area than the areas available in this country, for the reason that the Mexican lands are tributary to American towns and commercial centers. They are situated south of Yuma and the Imperial country and while the development will be on Mexican soil, the outlet will in large measure be through American towns and over American highways.

Before the river can be utilized fully it will require a treaty with Mexico under which the two governments can operate to define the rights of both and to insure the payment by Mexico, of her portion of the expense of reclamation. Such a volume as Mr. Hill proposes to write will be authoritative, covering the official studies of the river to date and will of course be carefully studied by the two governments in connection with matters that are sure to arise in the future, whether immediately or a little later.

A FREE COURSE IN AGRICULTURE.

In order to encourage the study of advanced dairy methods the Missouri State Board of Agriculture offers a scholarship of $100 for the purpose of paying the expenses of a young man interested in dairying, during the short winter course in agriculture at Columbia, which begins November 1, 1911.

The scholarship is to be awarded to the winner of a contest in which those who enter will be required to keep a complete record of the amount of milk and butter fat produced by three or more dairy cows during the month of September. In determining the winner, the record made by the cows, together with the completeness of the report, is to count one-half. The other half is to be based upon the accuracy of an essay, telling how the cows were fed and cared for during the test and how the contestant would proceed to select cows for dairy purposes.

The contest is open to all boys in Missouri between the ages of 16 and 20 years who have not already attended an agricultural college. It is hoped that a large number of boys will enter the contest. The lessons learned during the one month of keeping records of both feed eaten and milk produced will amply pay any boy for his time and effort.

The records of each cow and the essay must be submitted before October 10, 1911. Blanks for keeping records, directions for testing and any further information wanted will be furnished by C. H. Eckles, Dairy Department, Columbia, Missouri.

Reclamation Notes

CALIFORNIA.

A deed was recently filed with the county recorder of Yuba County transferring a portion of the Browns Valley Irrigation district to Thomas Turner of Browns Valley. Turner intends to use the property he has acquired in connection with an irrigation project he is promoting. The opening of this district adjoining the Browns Valley district will bring many settlers to that section, as the territory affected is very rich land and with irrigation will be valuable for fruit raising and other agricultural pursuits.

The Sacramento Valley Colonization Company, who recently acquired and have been colonizing the Haggin tract, just north of Sacramento, have purchased the Chowchilla ranch, which contains nearly 110,000 acres in a solid body. The larger part of this land is in Madeira county and the remainder is in Merced county. The land is in the artesian belt and there are thirty-seven flowing wells on the property. The Chowchilla canal also furnishes water for irrigation and the lay of the land affords perfect drainage. The work of getting the property ready for market is proceeding with all possible haste and it is predicted that within a year the greater part of it will be acquired by colonists.

The tax rate for the coming year was fixed at $3.00 by the board of directors of the Modesto Irrigation district at their meeting held recently, all of the directors being present. This is an advance of over 45 cents over last year's rate and is due to the $25,000 special assessment. The rate was computed upon an assessed valuation of $6,003,385.

The detailed report of the board of army engineers especially appointed to investigate the various reclamation projects of the United States Government shows that there have been $3,781,355 spent on the reclamation work at Yuma. The report is the most exhaustive ever published by the government on this department of its work.

The Sacramento Valley Irrigation Company has decided to place upon the market a townsite to be known as Monroeville, on the line of the new Colusa & Hamilton City Railway. The new town site will be equipped with an underground irrigation system of concrete pipes placed far enough below the surface of the ground to insure a dustribution of water over the entire site. The land will be cut up in five and ten acre tracts and placed on the market.

Thirty-five thousand acres of land in Contra Costa county are to be put under irrigation by a company of capitalists which has been organized for the purpose. Water is to be taken from the San Joaquin river at a point near the little town of Oakley. The district will extend from the town of Bay Point on the bay shore to the San Joaquin county line and to the slopes of Mt. Diablo.

That Alturas is to be the center of the largest colonization work in Northern California in many years now seems to be an established fact. There are to be three large and four small reservoirs put in. The region will be reclaimed, ditches dug and the land planted to alfalfa and grain.

The main canal of the Thornton Irrigation Company has been completed at Thornton, and work will be started on the laterals at once. The water for irrigation is pumped from the Mokelumne river when the water is low, and during the season when the water is high the pump acts as a suction and the water is carried to the land without cost.

By the construction of a water ditch three miles from the Butte County canal, 6,000 acres of the Richvale colony have been placed under irrigation. About 6,000 more acres will be added to the irrigated land in a short time.

It is rumored that Eastern capitalists will soon form an irrigation project for the irrigating of the Farmington section of San Joaquin county with water obtained from the Salt Spring Valley reservoir. It is estimated that this reservoir will store enough water to supply 25,000 acres during the irrigation season.

COLORADO.

Plans to irrigate over 3,000 acres of land by a ditch and reservoir system were filed recently in the office of the county clerk. The new irrigation project will be built east of the city of Pueblo by the Adamson Ditch and Reservoir Company. The new project will cost somewhere in the neighborhood of $11,000 and will be completed some time next spring.

Denver, Rifle and Grand Valley capitalists have organized an irrigation project to water 20,000 acres of high mesa land south of the Grand river. The surveys cover land from Spring creek on Battlement mesa to the lower end of Bonita Park section. Practically all of the land involved belongs to the government.

Contracts have been closed for the irrigation of 3,000 acres of land in the Grand valley and 1,920 acres near Fort Morgan by means of pumps.

Contract has recently been awarded the McDowell Construction Company of Lamar by the people of the Omer Irrigation district for the construction of a system. The project consists of a dam across the Apishapa river and the construction of a storage reservoir for flow water, which will hold 20,000 acre-feet of water. The contract stipulates that work shall begin within sixty days and that the irrigation system shall be completed within one year. The Omer district, about twelve miles south of Fowler, is generally level, with good slope, and the soil when irrigated is as productive as any found anywhere in the valley.

Contract has been signed for boring of the 14,725-foot tunnel through the continental divide, twelve miles west of Empire, in Clear Creek county. The tunnel will carry the waters of the Williams Fork river, on the western slope, to the Henrylyn irrigation district, northeast of Denver. The main range tunnel will cost $589,000. The entire project to carry water from the western to the eastern slope, including a 3,000-foot tunnel and the necessary ditches, will represent an investment of $1,000,000.

The biggest land sale yet made under the new Hardscrabble Irrigation district was that of the Bean and Lancaster tracts, comprising 380 acres of the finest land in the very heart of the district. The tract in question has good improvement, 100 acres in alfalfa and 150 acres in other crops.

MONTANA.

The Reclamation Service announces its latest homestead undertaking, the Huntley irrigation project, in Montana, is fast being settled by the newcomers to the west, and that splendid crops of all sorts are being produced. One of the principal crops being raised with success in the new country is sugar beets.

In the Sun River Valley the government is constructing an irrigation project embracing about 250,000 acres of exceptionally fertile land. The first unit, known as the Fort Shaw Unit, is completed.

For the purpose of extending the main ditch of the Billings Land and Irrigation Company about two miles and constructing two miles of laterals between Crooked and Razor Creeks, surveys are being made. It is expected to begin work on the proposed extension immediately and will mean, when completed, a large acreage of land under irrigation which has heretofore been dry land.

NEW MEXICO.

L. E. Foster, resident engineer at Carlsbad, states that the United States Reclamation Service plans to make of the Carlsbad project a permanent proposition in all respects when the repairs now contemplated are completed. Mr. Foster gives out the plans of the improvement in detail, the whole amounting to $50,000 in cost instead of $40,000 as heretofore announced.

Articles of incorporation have been filed in the secretary's office by the Portales Valley Irrigation Land and Development Company at Portales, naming Basil J. Reagan as agent. The company is incorporated at $25,000.

The United States Reclamation Service has found it necessary to issue a warning against misrepresentations made by land agents as to the lands and prospects under the Elephant Butte project. Much harm may be done New Mexico by permitting small investors to be swindled or to be lured to New Mexico by stories that are overdrawn. The simple truth is good enough advertisement for New Mexico.

The completion of the reclamation works in the Arroyo Hondo and the placing under water and cultivation of five thousand acres of fertile lands means more to Santa Fe than the securing of a beet sugar factory or a steel mill.

OREGON.

A four million dollar reclamation project is contemplated by the United States Reclamation Service at Pendleton.

Land owners in the eastern part of Klamath county have presented a petition asking that a special election be called this fall to vote on establishing an irrigation district in the Langell and Yonna valleys. It is likely the court will grant the petition. About 25,000 acres in the valleys named are susceptible to irrigation.

UTAH.

The directors of the Provo Reservoir Company have decided to commence work at an early date on the Utah Lake irrigation project and pumps will be installed before snow flies. The project will be prepared to furnish water to land owners on the west side of the lake by next June. The project will cover 15,000 acres of land on the west side of Utah lake and also some in the south end of Salt Lake county.

The county commissioners, after considering the petition of people at Riverside for a pumping district for a long time, finally granted the request after eliminating from the district asked a considerable portion of land that is benefited by the West-Cache canal and which will come in the district asked for there.

Orchardists of the town of Perry have concluded that it is profitable to irrigate by electricity and during the past summer a number of electric wells have been sunk with the best of success by those experimenting in this way and obtaining a good flow of water.

WASHINGTON.

The Kittitas reclamation district was recently created at Ellensburg, Washington, by a vote of 350 to 10. The bond election will be held in 60 days and work on the big canal will be begun next spring.

Several hundred acres of land owned by the Priest Rapid Orchard Company have been taken over by B. R. McMahon. The price paid for the tract was $160,000. It is located on the banks of the Columbia river in the southeastern part of Washington and will be subdivided into orchard tracts and irrigated by the Columbia river.

Reports will have to be submitted by the Burbank Irrigation Company, of Two Rivers, Washington, within 30 days, detailing the progress of the work which was ordered done by the public service commission following a hearing of a complaint from the patrons of the company. The installation of a new irrigation unit, new ditches and flumes and a new auxiliary steam plant are some of the most important work prescribed in the order of the commission.

MISCELLANEOUS.

The Republican Valley Reservoir and Irrigation recently filed application and fee for water rights on 60,000 acres of land in Hitchcock and Dundy counties. The company, with headquarters at Denver, proposes to locate its reservoir in Cheyenne county, Kansas, the whole project to cost $1,481,000. The water will be taken from the south fork of the Republican river.

In looking into the matter of tracts which are subject to irrigation in the Missouri valley, South Dakota, it was found that in Hughes county there are seventy-seven sections which lie within one mile of the Missouri; in Stanley county there are sixty-five sections within a mile of the river, and in Sully county there are forty-five such sections. This means that there are 118,000 acres of land within a mile of the Missouri which could be placed under irrigation by small pumping plants.

The Nebraska Advisory Committee of the National Irrigation Congress has been called to meet in Lincoln. The committee comprises Grant Shumway, of Scotts Bluff; W. E. Guthrie, of Omaha; F. L. Haller, of Omaha; State Engineer D. D. Price and Secretary W. S. Whitten, of the Lincoln Commercial Club.

The Denver-Laramie Realty Company has a large force of men and teams at work upon an irrigation project twelve miles south of Laramie, Wyoming, at Hutton's

lakes, where they expect to construct a mammoth reservoir to water a large amount of land just south and west of Laramie.

Irrigation has brought La Salle county, Texas, into prominence the last three or four years. This county is situated southwest of San Antonio. Nearly all of the land under irrigation is along the Nueces river, where several dams have been constructed this summer which will afford capacity for the storage of a large amount of water and more land will be put under irrigation.

It is rumored that a Boston syndicate is looking into the matter of an irrigation project which is to take the flood waters of the Cheyenne river in the vicinity of Buffalo Gap and carry them out over the divide between White and Bad rivers for the irrigation of a tract of about 200,000 acres in the valleys of the White and Bad rivers, South Dakota. This is only another of the larger projects which are among the possibilities of the state of South Dakota for the next few years.

An irrigation project sufficiently large to put 200,000 acres of land in the Pecos River Valley under water is contemplated by Texas promoters. The estimated cost of the undertaking as planned will be $5,000,000 and the project will be one of the greatest irrigation systems in that country. A large dam will be constructed and it is planned to utilize extensive lakes for reservoirs and to distribute the water by means of gravity.

Webster Irrigation Company, Webster, February 6; $25,000; paid in, $25,000; shares, 250; fifty years.

Asherton Artesian Land and Irrigation Company, San Antonio; February 17; $600,000; paid in, $600,000; shares, 20,000; fifty years.

Nueces Irrigation Company, Denison, March 1; $10,000; paid in, $10,000; shares, 100; fifty years.

Espiritu Santo Irrigated Land Company, San Benito, March 8; $25,000; paid in, $25,000; shares, 250; fifty years.

La Ferria Mutual Canal Company, La Ferria, April 1; capital stock increased from $8,000 to $253,320.

Consolidated Mutual Reservoir Company, Grand Falls, April 12; $600,000; paid in, $600,000; fifty years.

Mission Farm Company, Mission, April 15; $45,000; paid in, $23,000; shares, 4,500; fifty years.

Los Indios Irrigated Land Company, May 17; $10,000; paid in, $10,000; shares, 10,000; fifty years.

La Lometa Irrigation & Construction Company, Brownsville, June 2; $5,000; paid in, $2,500; shares, 50; fifty years.

Medina Irrigation Company, San Antonio, June 16; $1,000,000; paid in, $500,000; shares, 10,000; fifty years.

Victor Irrigation Company, Midland, June 28; $125,000; paid in, $125,000; shares, 12,500; fifty years.

Beggs Irrigation Company, Topeka, Kan., July 17; $5,000.

Alamo Irrigation Ditch Company, Hansford; $1,000.

Adding the $245,000 increase in the capital stock of the La Ferria Mutual Canal Company, makes the total new capitalization of canal companies in the state during the year $3,184,000.

A series of analyses of the water of the Mississippi River, made by chemists of the United States Geological Survey, reveals the changes in its character at different points. At Minneapolis the water of the Mississippi is very simple in character, being distinguished only by secondary alkalinity, primary salinity or permanent hardness. At Moline, Ill., permanent hardness appears definitely among the properties of the Mississippi water, although it occupies a very subordinate position. At Chester, Ill., however, the character of the water appears to be greatly changed, for the analyses indicate that the proportion of primary salinity is much increased and the proportion of permanent hardness is more than doubled. This change is due to the highly saline waters received from the Missouri at this point between Quincy and Chester. From Chester to New Orleans the river water appears to undergo no permanent change in general character. Additional contributions of saline waters from the West, received through Arkansas and Red rivers, suffice to maintain in the water of the lower Mississippi that high proportion of salinity first derived midway in its course from the Missouri River.

A PAYING INVESTMENT.

The business of farming is one of the oldest and most stable occupations of man. It is one in which foresight may be exercised more than in almost any other.

FIG. 1.

FIG. 2.

The preparation at this time for next year's corn crop is a matter of business—the exercising of a little foresight, which experience has taught us is both safe and sound. A few hours spent now, before frost, in carefully selecting corn from the field may save days, weeks, and even months of labor next season.

The time will soon be at hand when every corn grower, regardless of his location, should take advantage of the opportunity of preparing for next year, by going into the field and selecting double the number of ears of good corn required for next year's planting, figuring 12 ears to the acre. This will take but little time, and experience has proved that it will be time well spent. Very few seasons have passed without there being more or less of a seed-corn famine.

Do not put it off; the rush and hurry of corn-husking time will not permit you to select the seed with care. It is bad practice, to say the least, and far from being in harmony with methods of good farming to save the seed corn, as we once did when we were boys, that is, while picking and when we thought about it, to throw a few big ears in the front of the wagon, which we hastily picked over when unloading the load. This was the corn that was used in producing the next year's crop, and usually the yield gave ample evidence of the neglect. It is to be hoped that this practice will soon form a part of our memories of the past.

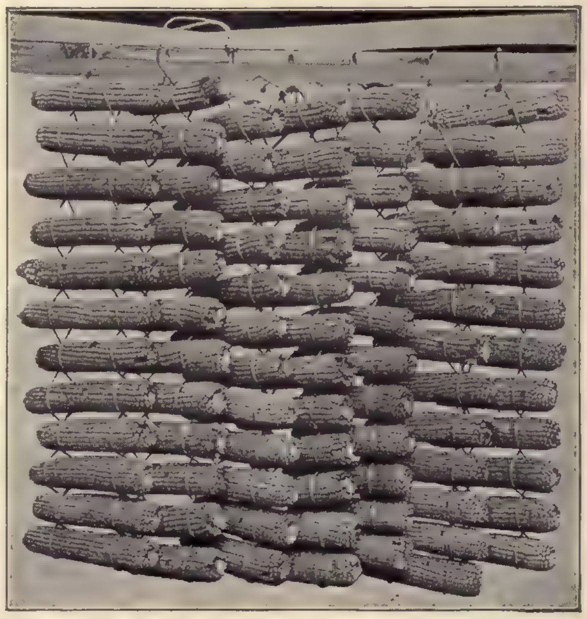


FIG. 3.

The seed corn should be picked before frost, and hung in a suitable place for drying. The advantages of this method are: First, we do not run the risk of having our seed corn frozen; second, we are able to pick ears from good stalks. The stalk should be of medium size, strong at the base, and tapering well toward the tassel. It has been said that "we are wise to know how strong the stalk must grow, to rear so fair a flower." The same is true and fully as important in raising corn.

The ears should be of medium size, rows straight, the butt well filled out, and the tip covered with corn. After the corn is picked, it should be hung up either in the open air, in the hay mow, driveway of some building, or some place where the ventilation is good, and where the corn is not subjected to the danger of freezing. The first month after picking is the most important in the care of the seed.

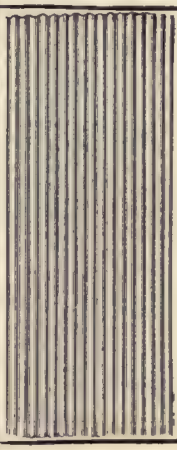
A good method to use in caring for seed corn is to hang it up by the use of strings. Take a piece of binding twine about 12 feet long, tie the ends together and place the first ear as shown in figure No. 1. Cross the strings and place in the second ear as in figure No. 2. Figure No. 3 shows method of hanging up the strings of corn. Note that this gives free circulation of air and that the ears do not touch each other. This method is inexpensive, but highly satisfactory.

SPECIAL OFFER TO READERS
OF
IRRIGATION AGE.

We are making special prices TO IRRIGATION AGE READERS on high-class merchandise that tell of great value giving, we present the strongest list of values we have ever been able to offer, quotations that have never before been equalled, our stock includes everything under the sun, no matter what your requirements may be we can supply you at bargain prices.

OUR RELIABILITY. Our capital stock and surplus in excess of **$1,500,000.00** is proof of our responsibility. Any publisher of any paper in America will tell you that "WE MAKE GOOD" on every statement. Write the greatest bank of the west—The Commercial Continental National Bank of Chicago.

We guarantee a saving of 30 to 50 per cent on every purchase.



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$1.25 per 100 Square Ft.

This Corrugated Iron, for roofing, siding, ceilings, linings, etc., is superior to all other coverings. It is rust, fire and lightning proof, cooler in summer, warmer in winter, and with ordinary care will last a life time; it is easily put on, the only tool you need is a hammer—which we give you free. Our lightweight, small size sheets are 22 inches wide by 24 long and 1¼ corrugated. It is unpainted. Our price quoted is for 100 square feet, not including lap, and, note carefully, that at this price we do not pay the freight. **Write today for samples** and our clear, easily understood roofing proposition. We have a complete stock of Plain, Flat, Corrugated, Standing Seam and V-Crimped Sheets. Suitable for all coverings.

Ask for Our Special Roofing Booklet

$37.50 BUYS THIS COMPLETE MODERN BATH ROOM OUTFIT

We have everything needed in Plumbing Material. No concern on earth is better equipped than we are. Every article carried in stock is guaranteed to be new and first class. By following our plans and instructions, the most simple and sanitary in the world, you can install your own material, thus saving the expense of a plumber.

BATH TUB. Heavy cast iron, 5-foot, enameled Tub, with a 3-inch roll rim: furnished complete with all nickel-plated trimmings above floor.

CLOSET. Vitrious earthenware, syphon wash down bowl, with a double lined steel tank; ivory white finish, genuine oak or near mahogany wood seat, flush mechanism of the latest type. Nickel plated supply pipe to floor and nickel plated flush elbow connection.

LAVATORY. Heavy cast iron, one piece, complete with all nickel plated trimmings above floor.

5-MS-101. Complete Bath Room Outfit, as described above. Guaranteed first class in every detail.... **$37.50**

Note: We can furnish fixtures ready for connection to Iron Pipe, extra...**$1.50**

$16.25 MODERN CENTRIFUGAL PUMPS.

Our "Modern" Side Suction Centrifugal Pump is designed and constructed on most liberal lines. Case (or shell) is of the solid type, very heavy. **The Runner** is of large diameter, adapting the pump for slow speed. **Inside of case is machine finished** and the runner machined and accurately fitted to case. The construction gives a closer running fit and greater efficiency than can be obtained in the old style split. **Shaft** is large and **bearings** generously proportioned. An ample stuffing box and gland is provided. Discharge can be readily adjusted to any angle. Parts are accurately interchangeable and can be promptly duplicated. We have them from **$16.25**—capacity 30 gallons—to **$725.00**—capacity 10,000 gallons.

IRRIGATION PLANTS.

Lap Welded Wrought Casings.

We have a large quantity of overhauled, lap welded wrought casing which is as good as new. The threads are newly cut and each length is fitted with a new coupling. It is not as heavy as the standard pipe, but it will stand equally as much and even greater pressure. This casing can be used for almost any purpose for which standard black pipe is used, and it is especially recommended for water, gas and oil lines. Owing to the fact that it is lighter than the standard pipe it has finer threads. Regular casing threads 14 to the inch. In connection with this casing we can furnish a full line of standard fittings which we will quote on request.

From 2½ in. outside diam..... **5½c** per foot
To 6⅝ in. outside diameter...... **35c** per foot

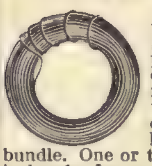
ASK FOR PRICES.

$96.75 BUYS THE BEST 4½ H. P. Gasoline Engine.

Our Success Gasoline Engine has become the most popular engine on the market today. Wherever these engines are seen running they make friends. They are the result of several years' experiment and are without a doubt the best all around engine on the market at any price. If you need any power at all to run your machinery, you cannot afford to be without one of these Success Gasoline Engines. We have handled other engines, but find that we have never sold any that gave as much satisfaction universally as our Success Gasoline Engine. We have never received a single complaint as to the workings of these engines.

30 DAYS TRIAL.

GALVANIZED WIRE SHORTS.
$1.35 For 100 Lbs. and up.



We carry a large quantity of wire shorts which enables us to guarantee a saving of 30 to 50 per cent. These are the mill ends of galvanized wire accumulated in the process of galvanizing. They come in lengths of 15 to 200 ft., put up in 100 lb. coils, 1 or 2 gauge to the bundle. One or two of these bundles will come in handy for repairing fences and anchoring fence posts. The low price at which we quote these wire shorts will not permit us to guarantee them beyond the actual weight of coil. As near as possible we keep one or two gauges to a coil. No farm is complete with one or two coils of these handy wire shorts. We also carry a complete stock of wire all sizes to cover every use to which a wire can be put.

SEND FOR OUR FREE LIST

KONKRETE CEMENT BLOCK MACHINES

The **Konkrete King Block Machine** is the most perfect and reliable machine on the market today. It has all the good features of other machines in addition to the improvements made from patterns owned by us. If this machine does not prove satisfactory, and if you believe it is not the equal or superior of any machine on the market—considering the price—we will allow you to return the machine and we will gladly refund full purchase price. Write for our Catalog showing a full line of Cement Block Machinery.

Konkrete Block Machine, complete for making 8x8x16-inch blocks. Weight, 175 pounds. Price.............. **$13.85**

MILLWORK

$1.95 Buys this strong, well made painted sash door, size 2 ft. 6 in. x 6 ft. 6 in. Glazed with double strength clear A glass, size 22x38. We have on hand thousands of these doors, windows and mill work of all kinds. Special mill work to order. Screens, Storm Sash, Interior Finish of all kinds, Mantles colonnades; all brand new stock, guaranteed manufacture at prices that are positively the lowest of all low prices. When comparing our prices with others, compare the quality too. You will find our prices the lowest and the quality as high as the highest.

SEND FOR PLAN BOOK

CHICAGO HOUSE WRECKING CO.
THIRTY-FIFTH AND IRON STS., CHICAGO

THE LENNON METAL FLUME

PATENTED

Nothing Newer, More Efficient nor Economical in Flume Construction

One of Our No. 98 Flumes Erected for the Stratton Estate, Colorado Springs. Capacity 40 Cubic Feet Water per Second on a Grade of Five Feet to the Mile.

¶ No wooden cross bars to catch drifting weeds, etc., and undermine trestle work by overflowing. ¶ No expense in boring holes in cross bars or other labor of erection. ¶ Do not leak. ¶ Made in any size and any length. ¶ Both smooth and corrugated. ¶ Made from both American ingot iron and special acid resisting steel. ¶ Steel trestle work for flumes erected. ¶ Write for literature and prices.

Manufactured by

The Colorado Ingot-Iron Pipe & Flume Company

Corrugated and Smooth Pipe, Syphons, Flumes, Headgates, Arches, Steel Trestle Work, etc.

COLORADO SPRINGS, COLO.

PAYS FOR ITSELF IN ONE MONTH

and Keeps on Saving You Money at the Same Rate Thereafter.

THE RECLAMATION DITCHER

Cuts Canals and Laterals for Less than any other machinery—because it plows the dirt out with *One Continuous Sweeping Motion.*

We guarantee the cost per yard and prove it before you buy.

THE ADAMS DITCHER CO.

Indianapolis, Ind.

Delays Pay No Dividends. **Mail This Coupon Today.**

The Adams Ditcher Co., Indianapolis, Ind.

Below are descriptions of our proposed ditches. What will it cost per cubic yard to make them with the Reclamation Ditcher?

Length	Width	Average Depth	Maximum Depth	Minimum Depth	Slope of Sides	Character of Soil

Name__________ Address__________

SUGGESTIONS FOR WINTER WHEAT GROWERS.

Winter wheat more than any other crop requires a good seed bed because of the adverse conditions through which it is required to grow.

In preparing the seed bed, first plow thoroughly and to a good depth. A firm, fine seed bed will have a tendency to prevent winter killing. If the soil is left loose and unpacked, the roots will grow deeper in a vertical condition, and as the soil is heaved by freezing and thawing, they are very apt to be broken. While if the seed beds is firm, the roots will develop more in a horizontal direction and thus rise and fall with the soil as it freezes and thaws.

If your soil is poor and unproductive, you will find that stable manure is the best fertilizer you can use. It will not only supply plant food, but will improve the physical condition of your soil. The best plan to follow in using commercial fertilizer, is to study your soil needs and then apply the kind of fertilizer that will give the best returns.

To continue to raise a good crop of winter wheat it is best to follow a careful rotation of crops. By growing wheat year after year, there will be a tendency for the yield to decrease even though good methods of fertilizing are followed, but by careful rotation of crops, it will be possible to keep the yield more nearly the normal amount.

Select a variety of seed that is adapted to your locality and to your soil. This can be determined best by comparison or by selecting seed from localities that are of similar climate. If you are in doubt about the variety, write your State Agricultural College, for they will probably be able to give you this information.

The wheat used for seed should be tested. Of course, you cannot test it as you do your seed corn, but you can sprout a small quantity. Grain that tests less than 90 per cent should not be used for seed. However, if it is necessary to use such seed, allowance should be made in the amount sown per acre.

There are two kinds of smut prevalent in wheat which greatly decrease the yield and also the quality. The methods of treating for smut may be obtained by writing your State College.

It is highly important in growing winter wheat that only plump and good kernels be used for seed. The strength and vigor of the plant is determined very largely by the kernel from which it grows. Professor Zabits, of Ontario, has found that by carefully fanning and grading the seed and planting only bright, plump kernels, the yield can be increased as high as 33 per cent over the amount harvested when average seed of the same variety is used.

Preparing the Seed Bed.

Use the grain drill, for it will plant the grain at a uniform depth which will insure the grain coming up at more nearly the same time. By experiments it has been found that drilled grain will produce from three to nine bushels more per acre than broadcasting.

In sections where the Hessian fly is troublesome, it is best to plant as late as possible, but care should be exercised not to plant too late, for if the plants are not strong, they are more susceptible to winter killing. On the other hand, if planted too early, a green luxuriant growth may result which is apt to be injured by freezing and thawing.

If your wheat seems to be falling off in quality and in yield, or seems to be mixed with other varieties, build it up by obtaining some good seed of the variety adapted to your locality. Plant this seed in a patch by itself. The seed patch need be only a few acres at the side of your field, and may be planted first. Use only the very best grain for planting this patch.

In raising winter wheat, remember that it pays to:

Select a variety of grain adapted to your locality.

Fan and grade your seed.

Test your seed.

Treat for smut.

Prepare a firm seed bed.

Use a drill.

Control the Hessian fly by time of planting, and by destroying infected straw.

Grow a seed patch.

OFFICIAL NOTICES.
DEPARTMENT OF THE INTERIOR.

The Secretary of the Interior has authorized the holding of an auction sale on September 27 of town lots in the Government townsite of Simms, one of the new towns on the Sun River irrigation project, Montana.

These lots include some of the most desirable business and residence sections. Simms is surrounded by a large area of irrigable land occupied by a very desirable class of settlers. It lies about 30 miles west of Great Falls on the Sun River branch of the Great Northern Railroad, now under construction.

The irrigable area is being extended as rapidly as the necessary works can be constructed, and this sale offers exceptionally good openings for a lumber and coal yard, implement house, elevator, bank, drugstore, creamery, blacksmith shop and livery stable.

The Secretary of the Interior has issued the following order for the Lower Yellowstone irrigation project, Montana-North Dakota:

By order issued May 1, 1911, under the provisions of the act of June 17, 1902 (32 Stat., 388), known as the Reclamation Act, and the act of February 13, 1911 (36 Stat., 902), anouncement was made that water-right applications at $45 per acre could be made and filed with the special fiscal agent of the Reclamation Service for the before May 24, 1911. In compliance with request made to the Department for an extension of this period, it is hereby ordered that water-right aplications may be accepted on or before December 1, 1911, if presented to the special fiscal agent of the Reclamation Service for the project, accompanied by a payment of $1.50 per acre, and such water-right application if finally accepted in the manner provided by the said order of May 1, 1911, shall be subject to all the conditions and limitations thereof.

The Secretary of the Interior has authorized the Reclamation Service to execute contract with Mr. Orrin H. Stratton, of Spokane, Washington, for furnishing 1,215 lineal feet of 28-inch wood stave pipe on the Tieton unit of the Yakima irrigation project, Washington. The contract price is $4,720.

Supreme Court Decisions

Irrigation Cases

INTERFERING WITH DIVERSION OF WATER.—

Where a bill to enjoin defendants from interfering with complainant's diversion of water from a natural stream for irrigation purposes, and to determine the several rights of the parties to the waters of the stream, alleges facts apparently sufficient to warrant the relief demanded, the fact that the bill also prays for a permanent injunction restraining defendants from interfering with complainant's ditch and works and physically injuring the same merely makes such relief incidental, and all the parties interested in the waters of the stream must be made parties. *Washington State Sugar Co.* v. *Sheppard,* U. S. Circuit Court, District of Idaho, 186 Federal 233

OBLIGATION TO FURNISH WATER.—

A lease of land under an irrigation ditch by an irrigation company provided that the lessees agreed to use the lateral ditches on the land, and to divert the necessary water for its irrigation so as not to interfere with the necessary flow of water through such lateral ditches for the irrigation of other lands controlled by the lessor, provided that the lessees should at all times, when necessary, divert from the lateral ditches two cubic feet of water per second of time. Held, that such lease obligated the lessor to furnish at least two cubic feet of water per second for irrigation of the leased land without reference to the requirements of other lands supplied by such lateral ditches. *Wyoming Cent. Irr. Co.* v. *Burroughs.* Supreme Court of Wyoming. 115 Pacific 434.

New Headgate on the Vermejo River, New Mexico. Capacity 1,400 Cubic Feet Per Second.

INJURIES FROM IRRIGATION WORKS.—

A corporation, to supply water to its stockholders for irrigation, built a canal, and defendant, on acquiring the canal, constructed a dam and spillway at a point about three-fourths of a mile short of its previous terminus, beyond which individual stockholders alone used the water for irrigation purposes. It had been the custom for stockholders to turn the water from the canal into their laterals, and for those who used water beyond the spillway to turn the water down the old canal at that point, and the corporation merely exercised supervision to the end that no more water should be taken by any individual user than the amount to which he was entitled. Water causing injury to an owner of land was turned down the spillway by a stockholder entitled to use it. Defendant did not contract with the stockholders below the spillway as to taking over the ditch. There was no appreciable change in the use of the canal below the spillway, after its construction, from the use before that time. The head gate in the dam below the spillway was defective, and defendant failed to make any provision for caring for surplus water. Held to show that the stockholders were agents of defendant, and it was liable for the injuries sustained. *Billings Realty Co.* v. *Big Ditch Co.* Supreme Court of Montana. 115 Pacific 828.

BRIDGING CANALS.—

Civ. Code, § 551, which provides that no canal can be laid out, constructed, or maintained so as to obstruct any public highway, and that the one so maintaining or using such a canal must repair the bridges, etc., was enacted in its present form in 1905. Before that it provided that every water or canal corporation must construct and keep in good repair at all times for public use across their canal, flume, etc., all the bridges that the county may require. This section was based on prior statutory provisions, passed nearly half a century before. Pol. Code, § 2694, provides that when highways are laid across canals on public lands those using the canals must prepare them so that the highway may cross without danger, and section 2737, providing penalties for obstructing or injuring highways, contains provisions for bridging ditches which cross pre-existing highways. Held that, in view of these provisions the original act did not impose upon the owners of canals the duty of bridging them whenever the public should lay out a road over them, and that the present section does not impose that duty, for the word "maintain," which is the basis of the claim, should be construed merely as a prohibition against maintaining a canal in such a way that it would injure an existing highway. *City of Madera* v. *Madera Canal & Irrigation Co.* Supreme Court of California. 115 Pacific 936.

New Headgate on the Vermejo River.

The half-tone illustration shown on this page gives a good view of a substantially built headgate on the Vermejo river in New Mexico. The works are all constructed of steel and concrete and are giving full satisfaction under the heavy flow of 1,400 cubic feet per second. It is a magnificent example of what is being done in the west in the way of permanent irrigation plants.

COME TO VIRGINIA

Homes for all, health for all, happiness and independence for all. Ideal climate; no malaria, no mosquitos. Write for our land bulletin which will interest you.

J. R. Meadows, Appomattox, Va.

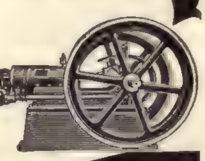
WITTE ENGINES

GAS—GASOLINE—DISTILLATE—NAPHTHA

Do the work at average cost of **One Cent** per horse power hour. Immense saving by our method of "pre-heating" the fuel. Built so perfectly that repairs cost less than **$1** per year average. Every valve is **vertical** and will not wear on the stem or slip inside. Freezing cannot injure bed as **cylinder and base** are **separate.** Hammered steel cranks, cut gears, etc.

GUARANTEED FIVE YEARS

We are experts in engine building; have done nothing else for twenty-six years. Our reference is thousands of satisfied customers. Our prices are right. All sizes, 2 to 40 H. P. Special inducements to introduce in new localities.

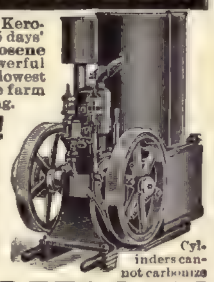


Write for free catalog stating size wanted.

WITTE IRON WORKS CO.
1605 Oakland Avenue, Kansas City, Mo.

Use KEROSENE Engine FREE!

Amazing "DETROIT" Kerosene Engine shipped on 15 days' FREE Trial, proves **kerosene** cheapest, safest, most powerful fuel. **If satisfied,** pay lowest price ever given on reliable farm engine; **if not,** pay nothing.



Cylinders cannot carbonize

Gasoline Going Up!

Automobile owners are burning up so much gasoline that the world's supply is running short. Gasoline is 9c to 15c higher than coal oil. Still going up. Two pints of coal oil do work of three pints gasoline. No waste, no evaporation, no explosion from coal oil.

Amazing "DETROIT"

The "DETROIT" **is the only engine that handles coal oil** successfully; uses alcohol, gasoline and benzine, too. Starts without cranking. Basic patent—only three moving parts—no cams—no sprockets—no gears—no valves—the utmost in simplicity, power and strength. Mounted on skids. All sizes, 2 to 20 h. p., in stock ready to ship. Complete engine tested just before crating. Comes all ready to run. Pumps, saws, threshes, churns, separates milk, grinds feed, shells corn, runs home electric-lighting plant. **Prices (stripped), $29.50 up.**
Sent any place on 15 days' Free Trial. Don't buy an engine till you investigate amazing, money-saving, power-saving **"DETROIT."** Thousands in use Costs only postal to find out. If you are first in your neighborhood to write, we will allow you **Special Extra-Low Introductory** price. Write!
Detroit Engine Works, 371 Bellevue Ave., Detroit, Mich.

For Father, Son, Brother, Uncle, Nephew or Grandpa

$5.00 Safety Razor for only 97 cents

Beautifully silver plated, with stropper, handle and holder, a full set of Grains Celebrated Wafer Blades, all in a handsome lined leather case, just like the high grade $5.00 outfits sold in stores. Remember this special Advertising Offer is for a short time only in order to introduce in every city, town and hamlet in the United States.

All you need to do is to refer to this ad, enclosing **ninety seven cents,** with your name and full address and the complete Grains Safety Outfit, exactly as described will be sent at once fully prepaid.

L. C. GRAINS COMPANY
13 Pulsifer Bldg. Chicago, Ill

500 LATEST SONGS 10c

The greatest collection ever offered, with **PIANO MUSIC.** Nearly every song you ever heard. Sung, whistled and played everywhere. No one else has them

Angel Eyes
Casey Jones
Silver Bell
Red Wing
Rainbow
Honey Boy
Lovelight
Honeyland
Stingy Moon
Pal of Mine
Let It Alone
Pony Boy
Grizzly Bear
Naughty Eyes
Winter
Dreaming
Pawnee
Napanee
Stop, Stop, Stop
Steamboat Bill
Cubanola Glide
Clover Blossoms
You're an Indian
My Post Card Girl
When I Marry You
Sweetheart Time
Just for a Girl
Sweet Italian Love
Garden of Dreams
Love's Young Dream
Captain Baby Bunting
All that I Ask is Love
If I Only Had the Nerve
Tittle, Tattle, Tattle Tale
Make a Noise Like a Hoop
Let Me Call You Sweetheart
Will the Angels Let Me Play
Has Anybody Here Seen Kelly
By the Light of the Silvery Moon
Call Me Up Some Rainy Afternoon
I Wonder Who's Kissing Her Now
Put On Your Old Gray Bonnet
A Lemon in the Garden of Love
I Could Love a Million Girls
When the Moon Plays Peek-a-Boo
The Sweetest Girl in Dixie
Play That Barber Shop Chord
Like the Rose You're the Fairest Flower
To the End of the World With You
Your Lips, Your Eyes, Your Golden Hair
Come Josephine in My Flying Machine
Any Little Girl That's a Nice Little Girl
That's What the Rose Said to Me
Abraham Jefferson Washington Lee
I Just Can't Make My Eyes Behave
I Miss You in 1000 Different Ways
Longest Way Round is Sweetest Way
Next to Your Mother Who Do You Love
I'm Starving for One Sight of You
I Want Someone to Call Me Dearie

$400 PIANO FREE and thousands of other costly presents given to persons who answer this. Send **10 cents** today for this **BIG SONG ALBUM;** 3 copies 20c. Address **STAR MUSIC CO., Dept. CHICAGO, ILL.**

IHC WAGONS HAVE STOOD THE TEST OF ALL LOADS AND ROADS FOR YEARS

THE real proof of the strength, durability, and value of I H C wagons is what they have done and are now doing for thousands of farmers throughout the country. Light loads and heavy loads have been carried by I H C wagons, over good roads and bad roads, for so many years that there is hardly a farmer who is not familiar with the high quality that these names on wagons represent—

Weber New Bettendorf Steel King

The reputation gained by these wagons is not due to any one particular feature but to all-round perfection and superiority of the design, the material, and the workmanship used in their construction. They are built especially for the western country and every feature that will increase their wearing life is incorporated in their construction.

WEBER wagons have been leaders for sixty-six years. All the wood is carefully selected and straight grained. It is air-dried for at least two years—so that the sap is retained, giving the wood wonderful stamina. Hickory is used for axles, single-trees, double-trees, and neck-yokes. Oak is used for hubs, hounds, bolsters, reaches, and sandboards. Oak and hickory are used for spokes. The New International stake is also furnished. This is one of the greatest conveniences ever added to a wagon.

NEW BETTENDORF is a steel gear wagon of standard quality with carrying capacity unexcelled. It is the only gear having an axle with removable malleable sleeve which can be replaced when worn.

STEEL KING has the only perfect adjustable stake; hollow steel axles and bolsters made to resemble the old wooden type; skeins are cast and can be easily replaced; wheels are A-grade; wagon box of best quality and construction.

I H C WAGON BOXES have long-leaf yellow pine bottoms, box-board sides, protection for the bottom over the front and rear bolsters, and the best box binders ever furnished. A tool box is attached to the front end.

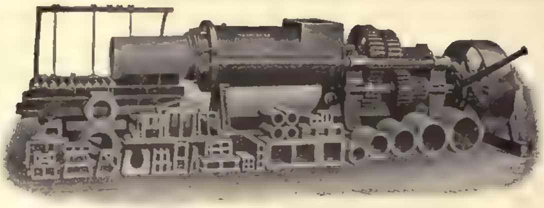
Do not buy any wagon until you see the I H C local dealer. It you prefer, write nearest branch house for literature in which you are most interested.

WESTERN BRANCH HOUSES—Denver, Col.; Helena, Mont.; Portland, Ore.; Spokane, Wash.; Salt Lake City, Utah; San Francisco, Cal.

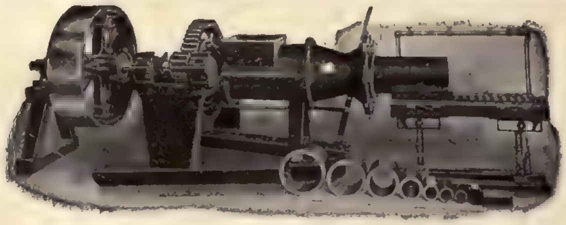
INTERNATIONAL HARVESTER COMPANY OF AMERICA
CHICAGO (Incorporated) **U S A**

I H C Service Bureau

The purpose of this Bureau is to furnish farmers with information on better farming. If you have any worthy questions concerning soils, crops, pests, fertilizer, etc., write to the I H C Service Bureau, and learn what our experts and others have found out concerning those subjects

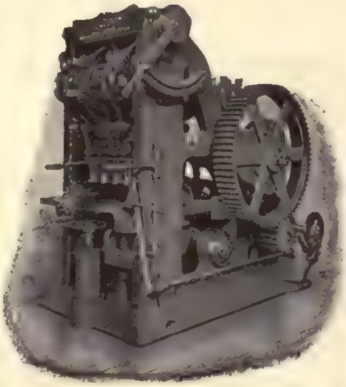


Centennial Auger Machine

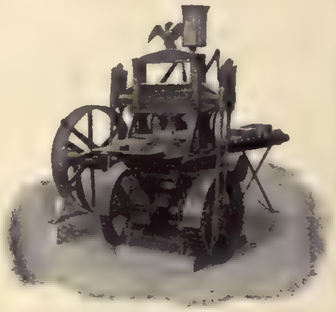


Mascot Auger Machine

Wheelbarrows and Trucks



Dry Press, 5 styles



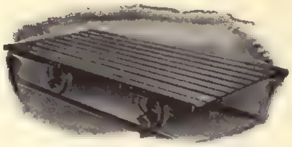
Eagle Repress

Clay Working Machinery

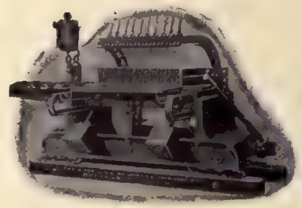
"BUILT RIGHT—
RUN RIGHT"

We build an entire line of Clay Working Machinery for the manufacture of Clay products by all processes, including Sand-Line Brick. Our yard supplies are the best. Kiln Irons, Cutting Wire and all supplies. Send for information or catalogue.

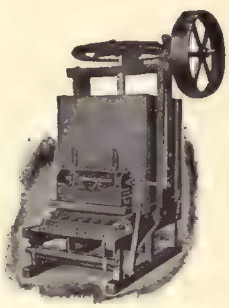
The American Clay Mch. Co...Bucyrus, Ohio



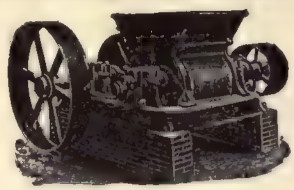
Dry Cars, all kinds



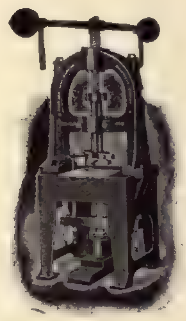
Hand and Power Cutters



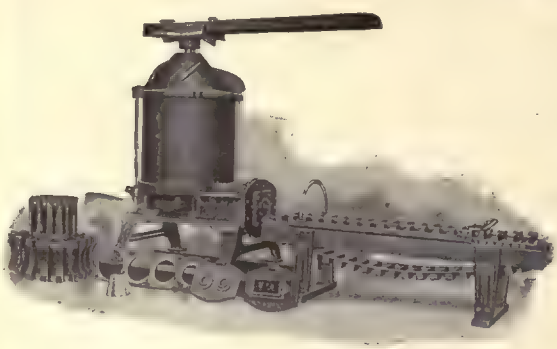
Soft Mud Machines, Horse and Steam Power



Disintegrators



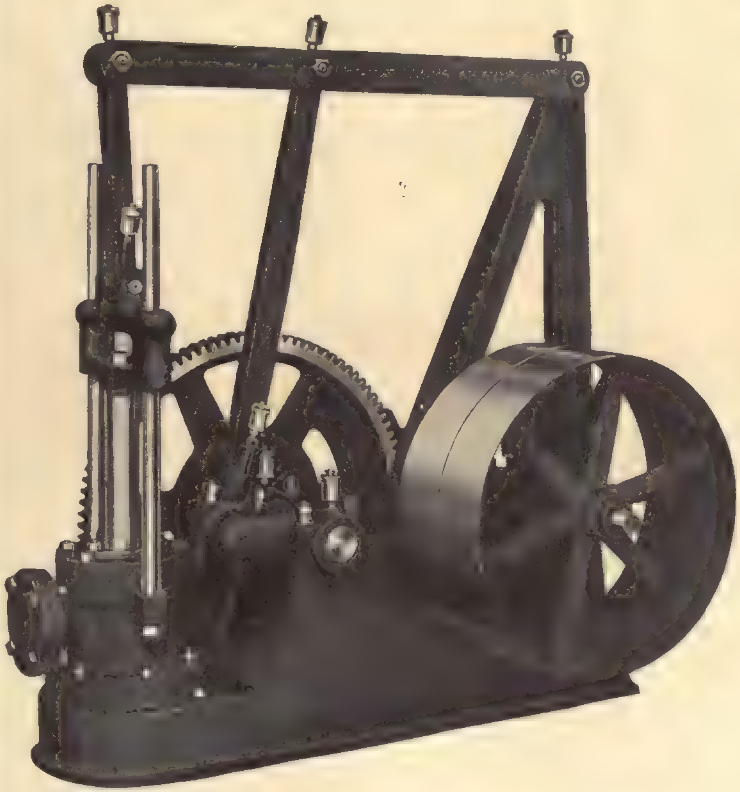
Hand Power Screw Press

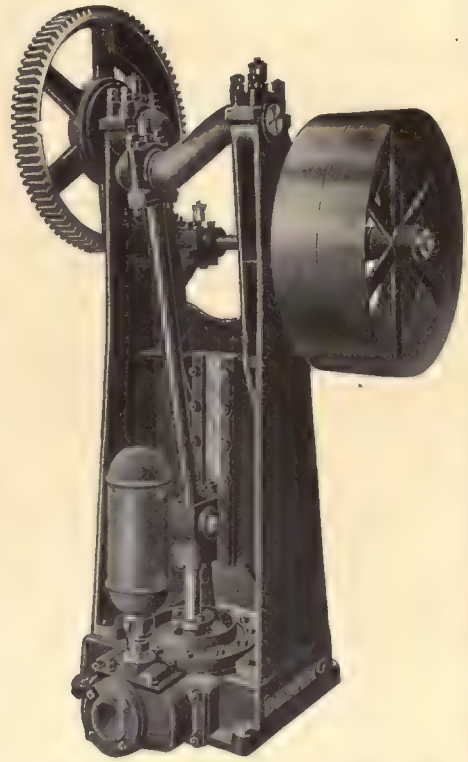


Horse Power Plunger Machine

Products of our Auger Machines

Deep Well Working Heads





These Working Heads Can be Operated by Electric Motor, Gas or Gasoline Engine, Steam Engine or Belt Driven—the Motors and Engines being Direct Connected if Desired.

The chief advantage to the possessor of a Deming Deep Well Working Head is in the immense saving of power money in direct proportion to the great depths from which the water can be pumped.

Then, too, our working heads have differential or double acting cylinders—discharging water at each stroke. Anyone desirous of securing water from deep wells for private estates, farms, etc., could purchase one of the smaller sizes and use it to excellent advantage. Of course we make other larger sizes for irrigating—those in the illustrations having 24 inch stroke.

If you expect to install a private irrigating plant, or need a pump of any kind, we should be glad to have you write us, giving conditions under which the pump would have to work. Our engineering department would then give you full information.

THE DEMING COMPANY, SALEM, OHIO

HAND AND POWER PUMPS FOR ALL USES
Including Spray Pumps, Nozzles and Accessories

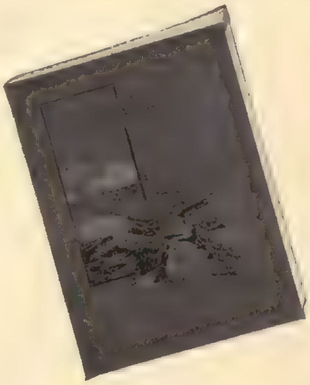
HENION AND HUBBELL, Chicago, Ill., General Western Agents
Other Agencies in All Principal Cities

THE
IRRIGATION AGE
VOL. XXVI — TITLE REGISTERED U.S. PATENT OFFICE — No 2

CHICAGO, DECEMBER, 1910

D. H. ANDERSON, Publisher

CHICAGO, ILLINOIS



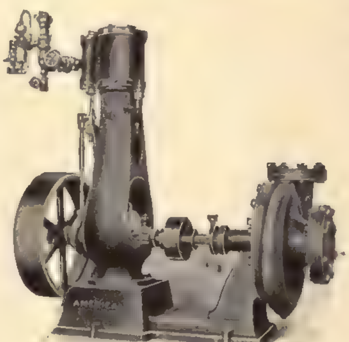
If You Irrigate by Pumping You Need this Free Booklet

Irrigation by gravity flow sounds well, but have you figured seepage losses in mains and laterals? It's not the water turned in at the head gates but the quantity actually placed on the cultivated land that counts in irrigation.

Did you know that many of the most economical irrigation systems in America are pumping propositions?

This booklet is entitled "Irrigation By Pumping." It is 8 x 11 inches in size, contains 57 halftone and line engravings of irrigation scenes and pump installations and describes all types of wells and the kind of a pump required for any location. It also illustrates and describes the three model irrigation pumping plants of this country.

While this book is published by The American Well Works, only one page is devoted to "American" pumps. The object of the booklet is to give the result of the 41 years of manufacturing experience of kinds of wells and the proper pump for any location of a firm that supplies more pumps for irrigation purposes than any other concern in America.



Just Off the Press

The Most Complete Centrifugal Pump Catalog Ever Issued

This catalogue is 8 x 11 inches in size, contains 128 pages and cover, illustrates and describes over 50 styles of centrifugal pumps, besides showing many installations and diagrams and contains over 20 pages of hydraulic tables. Many of these tables are not contained in any book on hydraulics published.

Write for these two books to-day, but be sure you mention "Irrigation By Pumping" and Centrifugal Pump catalogue No. 117 and that you saw the advertisement in the Irrigation Age.

AMERICAN

Catalog Directory

Catalog 105—Well Drilling Machinery. 8 x 11 in. 196 pages.
Bulletin 106—Standard Types of Well Drilling Machines. 6 x 9 in. 36 pages
Bulletin 107—Standard Types of Centrifugal Pumps. 3¼ x 6 in., 16 pages.
Bulletin 108—Centrifugal Turbine Pumps, 8 x 11 in. 8 pages.
Bulletin 109—Sand and Dredge Pumps, 8 x 11 in. 8 pages.
Catalog 110—Deep Well Pumps, 8 x 11 in., 68 pages
Bulletin 110 A—Standard Types of Deep Well Pumps, 3¼ x 6 in., 16 pages.
Bulletin 114—Rock Coring and Deep Blast Hole Drilling 8 x 11 in. 16 pages.
Catalog 115—Air Compressors, 8 x 11 in. 84 pages.
Bulletin 116—Double Suction Enclosed Runner Centrifugal Pumps, 8 x 11 in., 8 pages
Catalog 117—Centrifugal Pumps, Volute and Turbine 8 x 11 in. 132 pages.
Cost of Irrigation—3¼ x 6 in., 20 pages

The American Well Works

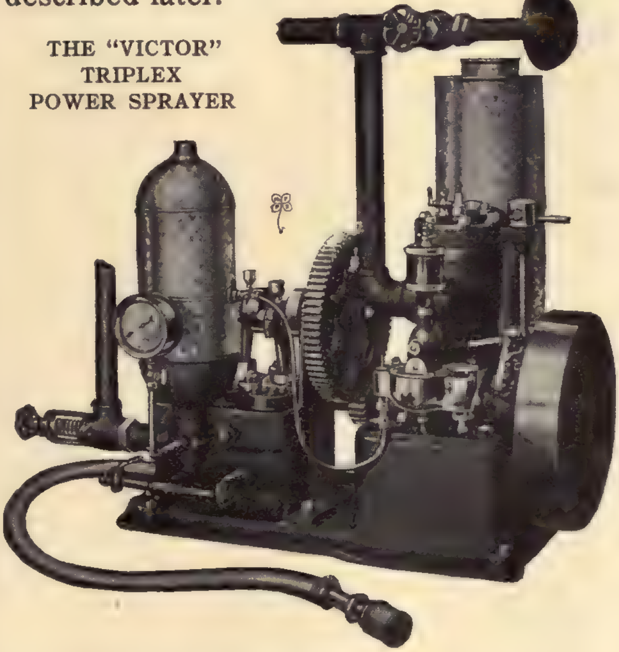
General Office and Works: Aurora, Ill., U. S. A.
Chicago Office: First National Bank Building

Deming Spray Pumps—A Frank Talk With Fruit Growers About Our Plans For 1911

The list of Deming machines for 1911 includes outfits adapted to the work of every grower. They are suited to large orchards or small, smooth ground or hilly, high altitudes where the atmospheric pressure is light, and valleys where conditions are normal. They are indeed the outfits for ***every*** condition and user.

We illustrate a couple of the best sprayers for large growers—others will be described later.

THE "VICTOR"
TRIPLEX
POWER SPRAYER



Get the "Bordeaux" and "Demorel" Nozzles for Your Work This Year

Deming Nozzles, like Deming Pumps, are made to render the greatest service to the grower—they are found wherever good spraying is done. They are made in seven styles, each of which has its advantages.

The best of all are the "Bordeaux" the "Demorel" and the "Simplex." Every Deming Nozzle, like every Deming Spray Pump, is carefully tested before it leaves the factory.

THE "SAMSON"
HAND
SPRAY PUMP

Catalogue and Full Particulars From the Nearest Deming Dealer

You hardware or implement dealer probably handles Deming Spray Pumps, or will secure full particulars and prices for you. If he does not carry the Deming line, drop us a postal and we will advise you, by return mail, where our outfits may be had, if we have an agency in your locality.

If we are not represented close by, we will forward Catalogue and full particulars, and quote prices for direct shipment. In any event, do not accept a substitute for the "Deming," but give us a chance to show you, as we gladly will, *why* and *how* Deming machines are *better.*

First Prizes were awarded Deming "Century" Barrel Spray Pump, and Deming "Bordeaux" and "Simplex" Nozzles at the National Horticultural Congress, November 10-19, 1910.

THE DEMING COMPANY MANUFACTURERS OF PUMPS FOR ALL USES

950 DEPOT STREET :: :: :: :: SALEM, OHIO

Distributing Agencies in Principal Cities — HENION & HUBBELL, General Western Agents, Chicago

THE
IRRIGATION AGE
VOL. XXVI
TITLE REGISTERED U.S. PATENT OFFICE
No 3
CHICAGO, JANUARY, 1911

D. H. ANDERSON, Publisher

CHICAGO, ILLINOIS

THE
IRRIGATION AGE
VOL. XXVI — TITLE REGISTERED U.S. PATENT OFFICE — No 4
CHICAGO, FEBRUARY, 1911

D. H. ANDERSON, Publisher
CHICAGO, ILLINOIS

THE
IRRIGATION AGE
VOL. XXV
TITLE REGISTERED U.S. PATENT OFFICE
Nº 5
CHICAGO, MARCH, 1911

D. H. ANDERSON, Publisher

CHICAGO, ILLINOIS

Deming Spray Pumps do Good Work
One 1910 Record That Proves It

When we tell you that Deming Spray Pumps are doing **good** work, **and lots of it,** and **doing it thoroughly,** we say so because we **know it to be a fact.** If you'd like to know just what **kind** of work we mean by that, we refer you to the accompanying table, showing the record made by a Deming "Premier Power Sprayer, Fig. 656.

With this machine one of our customers in Washington produced a 100% perfect apple crop, and covered his orchards in the least possible time, using only a comparatively small amount of spray material. This man made a real record with his

TIME and quantity of liquid used to spray 10-acre orchards in Washington State by a customer (name on request) who raised 100 per cent perfect fruit, using "New Way" Deming Power Spray Outfit, with 200 to 250 pounds pressure and Bordeaux nozzle.

	Hours Time	Gallons Liquid Used
4-year-old trees, 10 acres - -	7	700
5-year-old trees, 10 acres - -	15	1,500
6-year-old trees, 10 acres - -	20	2,500
7-year-old trees, 10 acres - -	24	3,000
8-year-old trees, 10 acres - -	26	3,500
9-year-old trees, 10 acres - -	30	4,200
10-year-old trees, 10 acres - -	35	5,000
11-year-old trees, 10 acres - -	40	5,700
12-year-old trees, 10 acres - -	40	5,700

Deming Spray Pump

for several good reasons that must appeal equally to **you.** For instance, every Deming machine is reliable. You don't often hear of Deming users being thrown out by a breakdown. That's because we build machines that will work right along, even when used hard and put to heavy strain.

Then there's the splendid **construction** of Deming machines, and back of the construction, the **design**—every Deming outfit was planned by men who know how a good sprayer should be built, and what modern fruit growing methods demand.

Consult the nearest Deming dealer; if you don't know who he is, we'll tell you. We want you to have our catalogue, and have it NOW—so write us **today** and we will see that you get full particulars by return mail.

First prizes were awarded Deming "Century" Barrel Spray Pump, and Deming "Bordeaux" and "Simplex" Nozzles, at National Horticultural Congress, Council Bluffs, Iowa, November 10-19, 1910.

The Deming Company, 950 Depot St., Salem, Ohio.

MANUFACTURERS OF PUMPS FOR ALL USES

Henion & Hubbell, Chicago. **Distributing Agencies in Principal Cities**

THE
IRRIGATION AGE

VOL. XXV

TITLE REGISTERED U.S. PATENT OFFICE

No 6

CHICAGO, APRIL, 1911

D. H. ANDERSON, Publisher

CHICAGO, ILLINOIS

THE IRRIGATION AGE

VOL. XXV — TITLE REGISTERED U.S. PATENT OFFICE — NO 7

CHICAGO, MAY, 1911

D. H. ANDERSON, Publisher

CHICAGO, ILLINOIS

THE IRRIGATION AGE

VOL. XXV — TITLE REGISTERED U.S. PATENT OFFICE — Nº 8

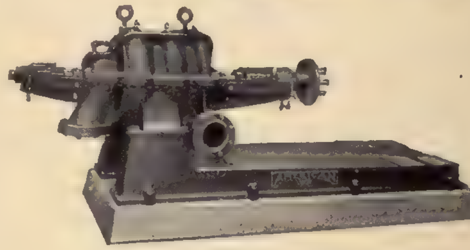
CHICAGO, JUNE, 1911

D. H. ANDERSON, Publisher

CHICAGO, ILLINOIS

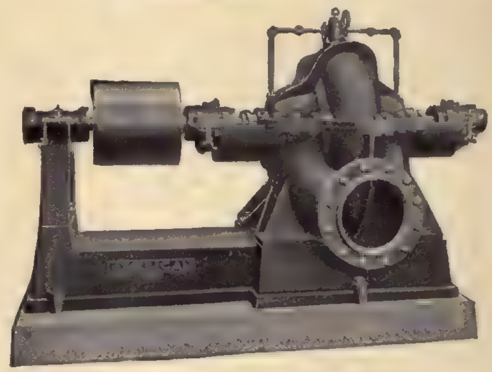
Why "American" Centrifugals
Are Most Economical in the Widest Range of Pumping Conditions.

The reason why "American" Centrifugals are unequaled for economy is that they represent the highest development of the most modern type of pump and there are the best of reasons for this higher development.

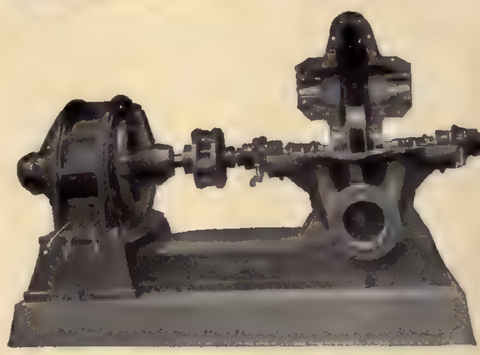


Instead of building a single type of centrifugal and recommending it for every purpose "American" centrifugals are built in over fifty distinct types and every size of every type is carefully tested in our own complete hydraulical laboratory and its efficiency proved before it is permitted to leave our works.

It must meet our standard of efficiency before it is allowed to leave our works and that is what is making the American trademark famous in pumping machinery.



"American" centrifugals attain up to 80 per cent mechanical efficiencies and many of our specially designed pumps, installed according to our own specifications, show much higher efficiencies, enabling them to operate against high heads. We have many single stage centrifugals installed operating on over 200 feet heads.

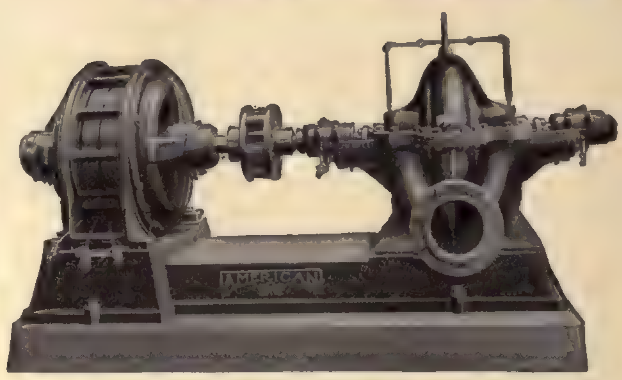


The low first cost of "American" centrifugals, as compared with old style plunger pumps, combining with their high efficiencies, low cost for attendance and small cost for repairs make them **far more economical** than any other type of pump in nearly all conditions where **all costs are considered.**

Greatest economy in the end is the claim we make for "American" centrifugals and we are ready to prove that claim.

If you are interested in irrigation, write for our booklet, "Irrigation by Pumping" Bulletin No. 118.

Our General Centrifugal Pump Catalog No. 117 is the most complete ever issued. Write for it today.



The American Well Works

General Office and Works: Aurora, Ill., U. S. A.
Chicago Office: First National Bank Building

THE IRRIGATION AGE

VOL. XXV — TITLE REGISTERED U.S. PATENT OFFICE — Nº 9

CHICAGO, JULY, 1911

D. H. ANDERSON, Publisher

CHICAGO, ILLINOIS

Let Our Skilled Engineers Solve Your Pumping Problems Without Obligation to You

We are water supply specialists.

In our Engineering Department are men who have made a life study of water supply conditions. For years they have daily been called upon to solve an ever-increasing variety of perplexing water supply problems.

If you have in mind an irrigation project for transforming a parched, useless tract into fertile, productive soil, you need the **service** which this Department can render.

Or perhaps you desire to install a private water system in your home—to have running water in every room—hot or cold, day and night.

In either case you will find invaluable the services of this corps of trained experts, whose knowledge and experience it is your privilege, if interested, to draw upon at any time, entirely without cost to you.

For over thirty years we have been manufacturers of hand and power pumps for all uses and conditions. In that time our skilled engineers have been constantly engaged in designing new equipment to meet modern pumping requirements.

A brief statement of the conditions under which the pumps must operate, accompanied by a rough diagram of the proposition, will be sufficient for us to work upon. Mark the envelope "For Engineering Department."

If you live near a large city, this department will turn over your proposition to our engineering agency in that city, after we have decided what equipment you need.

To save time, all the correspondence which follows will be in charge of that agency, and we of course always keep in close touch with every one of our agencies.

Bear in mind that this service is at your disposal without putting you under any obligation whatever. Why not take advantage of it?

THE DEMING COMPANY
SALEM - - OHIO

Hand and Power Pumps for All Uses

General Western Agents, Henion & Hubbell, Chicago

The "American" Deep Well Turbine

No Matter How Difficult the Pumping Conditions May be, There is a Pump Among the "American" Family of Centrifugals Especially Designed to Meet the Requirements

IT IS NOT alone the development of the centrifugal principle of pumping to its highest efficiency but producing a type to meet every possible condition that establishes the supremacy of the "American" centrifugal.

AMERICAN

The "American" vertical type Turbine Centrifugal is especially designed for pumping deep bored wells 12 inches and larger in diameter.

Study the details of construction of the two-stage vertical turbine, direct connected to vertical type motor, in the accompanying illustration.

This is what is known as a No. 24 turbine, and is inserted in a riveted steel well casing 24 inches inside diameter.

The pump has 9 inch suction and discharge pipes and is designed to deliver 900 to 2500 gallons of water per minute on heads to 100 feet.

Note the flexible shaft coupling below motor, the water step immediately below coupling which takes care of all end thrust on the main shaft, the pressure lubrication below turbines, excluding all grit from the lower bearings, and the inner casing surrounding the main shaft, making it impossible for grit and sand to reach any of the bearings of the pump and making possible the pumping of water containing a large amount of silt and sand.

Attaining highest efficiency and economy in any kind of pumping is what has made the "American" centrifugal famous.

"American," Centrifugals are described in Catalog 117, the most complete centrifugal pump catalog ever issued. Write for it.

If interested in irrigation write for "Irrigation by Pumping," Bulletin 118.

Special types of turbines are shown in Bulletin 122.

THE AMERICAN WELL WORKS

General Office and Works: Aurora, Illinois
Chicago Office: First National Bank Building

THE IRRIGATION AGE

VOL. XXV — TITLE REGISTERED U.S. PATENT OFFICE — No 10

CHICAGO, AUGUST, 1911

D. H. ANDERSON, Publisher

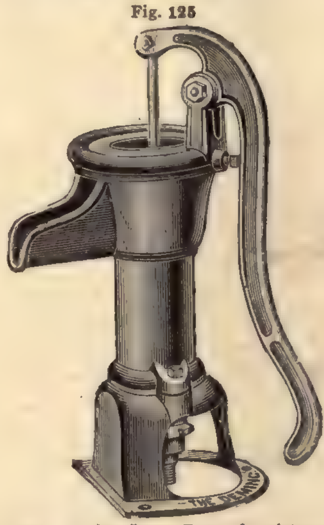
CHICAGO, ILLINOIS

When You Are Ready to Talk Water Supply—Let Us Know

Fig. 415½

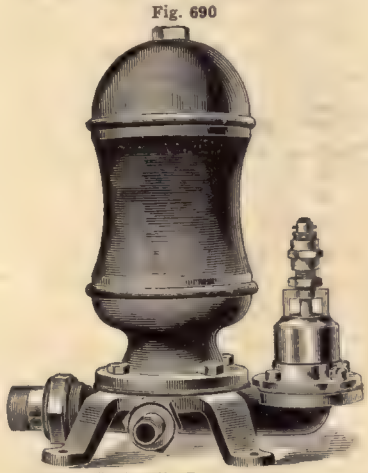
Deming Anti-Freezing Windmill Force Pump with differential cylinder and with three-way distributing valve for underground discharge.

Fig. 125



Deming Pitcher Spout Pump for cisterns.

Fig. 690

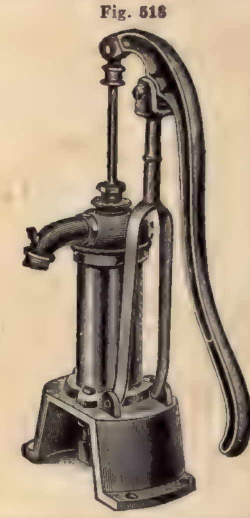


Deming Hydraulic Ram. You can have running water all the time with this machine.

Fig. 198

Deming Special Anti-Freezing Well Pump. Not suited for wells more than 28 ft. deep. Low priced but very strong and durable.

Fig. 518



Deming Cistern House Force Pump.

Fig. 580

Deming Windmill Irrigating Cylinder for heavy duty.

If you have been thinking about installing an irrigation system, home water works system, or securing any pumps at all, our Engineering Department will be glad to answer your questions on any of these subjects, without putting you under obligations in any way whatever.

Just give us a brief statement of what you want to do—or a rough diagram. We manufacture Pumps for all uses—hand, windmill, power and spray, also cylinders, etc., etc.

THE DEMING COMPANY, Salem, Ohio

Manufacturers of Hand and Power Pumps For All Uses

Henion & Hubbell, Chicago, General Western Agents

GENERAL AGENCIES

HENION & HUBBELL, Chicago — RALPH B. CARTER CO., New York

HARRIS PUMP & SUPPLY CO., Pittsburgh — MORAN ENGINEERING WORKS, Seattle

HENDRIE & BOLTHOFF MFG. & SUPPLY CO., Denver

The Efficiency of Every "American" Centrifugal Pump Is Proved by the Most Rigid Test

When you buy an "American" Centrifugal there is neither experimenting or guess work, it has been carefully tested under actual pumping conditions, its characteristics have been plotted and its accomplishment is accurately known.

Combining known efficiency with a pump designed especially to meet the conditions, no matter what they may be, instead of attempting to adapt conditions to a single type of pump, is what has built the reputation for efficiency and economy of the "American" Centrifugal.

It is the result of being pump designers and hydraulic engineers with the facilities for making the most exacting tests instead of being merely pump builders.

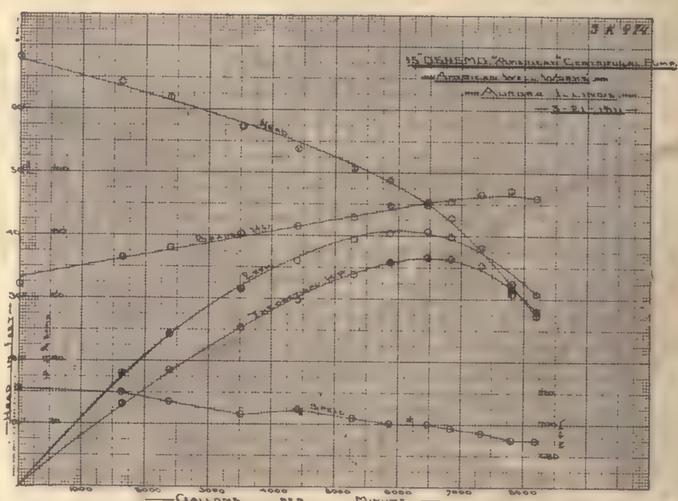
At the top of the page is shown an end perspective of the "American" hydraulic laboratory, located on the bank of the Fox River, immediately adjoining our works, where there is an abundance of water and where all pumps up to 36 inch are tested under actual pumping conditions.

No other maker of pumps has so perfect testing facilities and it is for the reason that we have deemed it necessary to go to this expense to maintain the standard of the "American" Centrifugal to the highest possible efficiency that is the best guarantee of its greater economy,

Every size of every type of "American" Centrifugal is carefully tested in this laboratory and it must meet our standard of efficiency before it is permitted to leave our works,

Here is a sample test:

The accompanying plotted curves are the characteristics of the pump illustrated at the bottom of the page.



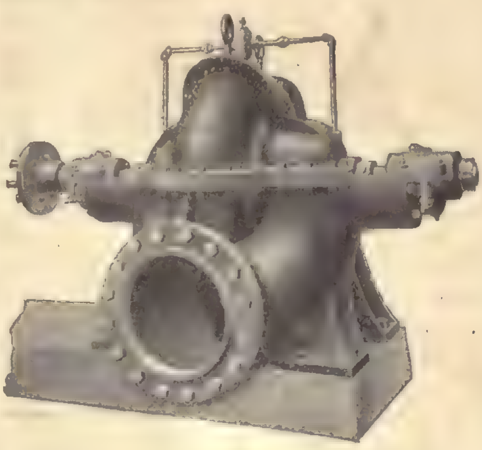
This pump has a 15 inch discharge pipe and was designed for irrigation pumping against a comparatively low head.

The characteristics show that it delivers 6,000 gallons per minute, against a 48 foot head when running at 700 revolutions per minute, consuming 88.5 horsepower and attains a mechanical efficiency of 81.5 per cent. But also note that the power curve turns down beyond the point of highest efficiency making impossible the burning out of the motor if the head is lowered.

And if you were to order any one of our 50 other regular styles of Centrifugals, or any of our especially designed Centrifugals, we are able to show the characteristics in the same manner and we are ready to *guarantee our efficiencies.*

The reason no other pump equals an "American" Centrifugal in efficiency and economy is because it is not only the highest development of the most modern type of pump but every claim made for it is definitely proved by actual test.

Our general Centrifugal catalog No. 117 is the most complete ever issued. Write for it.



The American Well Works

General Office and Works: Aurora, Ill.
Chicago Office: First National Bank Building

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CHICAGO, ILLINOIS

THE IRRIGATION AGE

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D. H. ANDERSON, Publisher

CHICAGO, ILLINOIS